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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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Scientific Worthies.

XLIII —Ivan Petrovitch Pavlov.

THE eminent physiologist, whose portrait is published to-day in continuation of the NATURE series of Scientific Worthies, was born on September 14, 1849, in the district of Rjasan in Russia. He was the son of the village priest After receiving some education at a theological seminary, he determined to devote himself to science and entered the University of St. Petersburg On the completion of his course in general science, he took the medical course at the Military Medical Academy, receiving his qualification to practise in 1879 At that time Botkin, the clinician, maintained several younger men as scientific assistants to carry on research in connexion with his wards, and Pavlov, after qualification, became his assistant, with special charge of the work involving animal experimentation. In 1883 he obtained the M D. of St. Petersburg, and in 1884 was appointed privat-dozent in physiology Immediately afterwards, he went for two years to Germany to work under Ludwig and under Heidenhain In 1890 the Institute of Experimental Medicine was built at the cost of Prince Oldenburg, von Anrep being appointed its first director, and in 1891 Pavlov became director of the physiological department of the Institute. In 1897 he was called to the professorship of physiology in the Military Medical Academy, without, however, giving up his post in the Institute of Experimental Medicine, and in 1907 he became one of the four scientific members of the St Petersburg Academy and obtained in this way another laboratory under his charge His work from this time forward, therefore, was carried on in three laboratories, his own personal experiments, however, being confined to the Institute of Experimental Medicine, the other two laboratories being in charge of assistants, though the work at all three places was inspired directly by Pavlov and subject to his continual oversight and criticism

Pavlov married quite young, his wife being a teacher in a school and herself the daughter of a village priest. He has had four children, one of whom is a well-known physicist who has worked in Cambridge under Sir Joseph Thomson and is now professor of physics in Leningrad.

Pavlov's scientific work falls easily into three well-defined chapters, though there is a certain leading idea which has guided him throughout and characterises all the researches for which he has been responsible. He set himself from the beginning to elaborate the analytic method of research Each function of the body has to be studied in relation to other functions as well as to external conditions, and the exact part played by each condition determined by artificial removal or arousal of the condition *while keeping the other conditions constant* Up to Pavlov's time the necessity for this last precaution had not been properly appreciated or systematically carried out Physiologists had been content to study functions in isolated organs or in animals in a profoundly abnormal condition, either through the action of anæsthetics or under the effects of discomfort or pain Pavlov realised that these disturbing factors, namely, anæsthetics, pain and discomfort, must be eliminated before the part played by excitation of a nerve, for example, under normal conditions could be appreciated, or proper value given to the results of operative procedure

We see the beginning of these ideas in the first chapter of Pavlov's scientific activities, those connected with the physiology of the circulation. The first papers published by him in German appeared in 1878–1879 and dealt with the normal regulation of the blood pressure in the dog In these experiments, Pavlov trained a dog to allow the insertion of a cannula in a small superficial artery on the inner side of the knee-joint and to remain quiet while the blood pressure was recorded. In such an animal he was able to study the effects of digestion as well as of drinking large quantities of fluid in the form of broth. He found that neither of these procedures produced any change in blood pressure amounting to more than about 10 mm of mercury In 1887 he published two papers on the efferent nerves of the heart, the first based on work carried out in St. Petersburg, while in the second paper he described the results of testing his previous findings with the use of Stolnikow's apparatus for measuring the output of the isolated heart. This research was carried out while he was studying in Ludwig's laboratory.

The work, however, for which Pavlov is best known is that connected with the physiology of digestion. Here the introduction of new methods devised to fulfil the conditions laid down by him at the beginning of his career enabled him to rewrite this chapter in physiology. At the present time our whole idea of the course of digestion is based upon Pavlov's discoveries. This work would have been impossible but for Pavlov's marvellous skill as an operator. Already in 1879 he had published three papers on the pancreatic secretion, and one of these described a new method which he had elaborated for making a pancreatic fistula, but from 1888 to 1900 all his activities were devoted to the problems of digestion In 1888 he showed that the vagus nerve was the secretory nerve to the pancreas, and also was able to explain why previous observers had failed to obtain any results from stimulating this nerve. In 1889 one of his pupils published a preliminary note in the *Centralblatt fur Physiologie* on the secretion of the gastric juice

It is in this note that we first find a description of Pavlov's method for obtaining pure gastric juice The animal was provided with fistulous openings into the stomach and also into the œsophagus. Such an animal had to be kept alive and in good condition by the introduction of food through the lower end of the œsophagus or directly into the stomach. It was essential, according to the rules laid down by Pavlov, that the animal should be kept in good condition, free from pain or even from discomfort. After such an operation these objects can only be attained by devoting extreme care to feeding the animals At that time there were no proper facilities for the care of animals, and this work could not be entrusted to an ordinary laboratory attendant. Pavlov, therefore, after operating on his dogs, took them home, and here in his small flat they were looked after by his wife, with the children.

The success of Pavlov's experiments was entirely due to the devoted care which was given to the animals. In a dog provided with an œsophageal and a gastric fistula Pavlov found that, within a few minutes of giving the animal food, there was a copious flow of juice through the gastric fistula. This was known as "sham feeding," and the secretion was proved by him to be due to the effect of appetite and was therefore named by him "psychical secretion." It could be aroused not only by eating but also by the mere sight of food, though it ceased as soon as the animal realised that the food was not going to be given to it. Pavlov proved also that the efferent channel for the psychical reflex was by the vagus nerves and that the secretion was stopped by section of the vagus nerves and was aroused by artificial stimulation of the peripheral end of a cut vagus nerve.

From 1892 to 1897 a whole array of papers on the physiology of digestion appeared in the *Archives des Sciences Biologiques*, so that Pavlov's discoveries became known to his colleagues in other countries. In 1897 a collected account of his work was brought out in German

Supplement to Nature, J[illegible] 3rd [illegible]

Lafayette photographer

Emery Walker ph.sc.

I. P. Pavlov

and in French under the title "Die Arbeit der Verdauungsdrusen" A little time later an English translation appeared from the German edition by Prof. W. H Thompson In 1904 Pavlov was awarded the Nobel Prize for medicine for his work on the physiology of digestion By this time, however, Pavlov's methods had become widely known through the agency of his pupils, many of whom had acquired sufficient operative skill to carry out the difficult operations which had previously depended on Pavlov himself, so that the work could be continued on the lines laid down in Pavlov's laboratory At the date of the award of the Nobel Prize, Pavlov had practically given up a direct personal interest in the subject of digestion and had taken up another subject

Hitherto, our methods of investigating the functions of the cerebral hemispheres have been extremely unsatisfactory We may study the effects of removal or excitation of definite areas in the cortex, but the results of such experiments have given rise to conflicting opinions as to their significance We know, for example, that in most mammals all the apparatus necessary for immediate motor reactions is contained in the parts below the hemispheres, and it is difficult to judge from the presence or absence of a response to some sensory stimulation after removal of portions of the cortex whether the cortical deficiency is really responsible for the effects, if any, observed More stress has been laid, therefore, on observations on man, where lesions have been produced in the cortex by disease or injury. Here, however, there is a tendency to abandon the pure physiological method, and in our arguments we are apt to jump continually from the objective to the subjective method and vice versa

Physiology is the objective examination and analysis of the behaviour of an animal under all manner of conditions. Up to the time when Pavlov began his researches, we lacked such objective physiological methods as would do for the analysis of the functions of the cortex the same services that had been rendered by physiological method in the hands of Sherrington for the analysis of the spinal reflex functions, or which have recently been used by Magnus and others in the investigation of the manner in which equilibrium is maintained or restored. We know that the cerebral cortex is what has been called the educatable part of the central nervous system: it is responsible for reactions which have been learnt in the course of the individual's existence. In the higher animals, especially in man, these learnt reactions overlie and take precedence of most of the immediate reflexes carried out by the spinal cord and brain stem, so that almost the whole of a man's behaviour throughout his adult life is carried out by a series of reactions to the environment for which the cortex is primarily responsible An analysis of the manner in which this complex never-ending series of reactions is built up so as to form an individual with his peculiar reactions, must begin with the simplest.

Pavlov conceived the ingenious idea of using the appetite reactions, with which his previous twenty years' work had made him so familiar, as an objective sign of cortical reactions It is well known that introducing acid or other gustatory substances into the mouth of a dog evokes a flow of saliva, and the intensity of the reaction can be measured by providing the animal with a salivary fistula and counting the drops or measuring the amount of saliva which is secreted in response to a given stimulus. Such a reaction is called by Pavlov an *unconditioned reflex* If, however, some other kind of stimulus, for example, ringing a bell, be associated for some time—weeks or even days—with the presentation of food or the introduction of acid into the mouth, the associated stimulus after a time is sufficient to evoke a flow of saliva without the presentation of food. This reaction was called by Pavlov a *conditioned reflex*. It is dependent on the laying down—the "education"—of new paths in the cortex. This method of establishing new reflexes has been used by him for investigating the higher functions of the cortex, the conditioned salivary reflex being employed as the unit sign of cerebral activity, just as the movements of flexion or extension of a limb have been used as a test for spinal function. Instead of studying the physiology of the eye, the ear, and other superficial organs, in its purely subjective aspect, we can use any of these sense organs for the establishment of a conditioned reflex or reflexes. We can proceed, untrammelled by psychological preconceptions, to study the behaviour of animals in its highest aspect by purely objective methods.

A preliminary account of his researches was given by Prof Pavlov in the Huxley Lecture which he delivered at Charing Cross Hospital on October 1, 1906 Since that time a very large number of researches carried out by this method have been published by Pavlov and his pupils, but almost entirely in Russian, so that they are very little known, except in broadest outline, in Great Britain and other countries It is satisfactory to learn that he is now engaged in writing a collected account of these researches which, when translated, will make them available for the instruction of physiologists, as well as psychologists, throughout the world, and will enable us to attack by this new method and with a greater hope of success the function of the cerebral hemispheres, which is indeed the capital question in the physiology of man

Pavlov was elected a foreign member of the Royal Society in 1907 and was awarded the Copley Medal in 1915.

E H STARLING.

Science and the Community.

IN an address delivered in connexion with the recent celebration of the centenary of the Franklin Institute, Philadelphia, and published in the Journal of the Institute for November, Dr. A D Little directs attention to the curious anomaly that although all the distinctive features of modern civilisation are due to discoveries made by scientific men, yet in no country in the world is the governing and directing power in their hands. It is an interesting but very familiar fact. Dr. Little, in his own engaging and energetic style, is only saying over again something that has been said by various eminent men of science for very many years It is a fact that not more than 100,000 men throughout the world are creatively engaged in the advancement of science, and yet a list of those features of our modern civilisation which distinguish it from the middle ages would show that they are dependent upon these men and could not continue without them. Nevertheless, the opinions of scientific workers are not asked on the direction of the civilisation that their kind have built up, nor are their services considered worthy of any special reward.

At first sight this state of affairs appears to be fantastic. Dr. Little vividly illustrates the astonishing disparity between service and award in a modern community:

"It is incomparably more profitable to draw The Gumps for a comic supplement than to write 'The Origin of Species.' There is more money in chewing gum than in relativity. Lobsters and limousines are acquired far more rapidly by the skilful thrower of custard pies in a moving-picture studio than by the no less skilful demonstrator of the projection of electrons The gate receipts of an international prize fight would support a university faculty for a year."

All this is, of course, quite true, but the implications are a little doubtful. Is it suggested that Einstein should be paid more than the custard-pie expert, or that the expert's income should be reduced below the level of that of a professor of physics? The custard-pie expert is paid directly by the public, for the amusement he gives them they pay him an immense income But the professor of physics does not amuse them, for the most part he bores them, and they are in no position to understand that his work is of real importance to their lives and to the lives of their children

It seems that Dr. Little is really finding fault with the cultural level of modern communities. We may look forward to a Utopia where the proletariat would rather attend a lecture on the tensor calculus than see a comedy by Charlie Chaplin, but we must admit that that time is not yet. A more pertinent comparison would be between the salaries of scientific men and of other public servants, since the value of the work in these cases is not directly assessed by the public

The implicit claim in the passage we have quoted, that scientific men should be rewarded with gigantic salaries, is probably not intended by Dr Little, although the confused feeling which gives rise to it is often apparent in discussions on this subject. The money value of work done is, with nearly every kind of work, extremely difficult to assess. Indeed, the problem is probably best defined in the case of the custard-pie expert, since, if a million people (including men of science) are willing to pay a shilling for his performance, it seems that the monetary value of that performance is one million shillings But who could possibly have assessed the monetary value of Gilbert's experiments in magnetism, or of Euler's researches on elliptic integrals? And what is the *monetary* value of the theory of relativity which, so far, has had no direct influence whatever on the life of the community? But although we think the scientific man is wrong to envy the income of the successful cinema actor, it is true that science has now sufficiently proved its value to enable the scientific man justly to insist on rewards that shall enable him to keep in good health, prosecute his work in proper conditions, and encourage him to produce and rear children. It is established that he and his offspring are a very desirable social asset; and the real injustice and stupidity of those in power are shown in the fact that even these minimum demands are not properly met.

Dr Little also complains that scientific men are not admitted to positions of power in the community In spite of the fact that some of them, particularly during the War, have shown themselves possessed of great administrative abilities, scientific men are not invited to co-operate in the task of government Yet, seeing how much the modern community is dependent upon their labours, it would seem only natural that they should be given a voice in the direction of affairs. But here again we are met by a demand that requires careful consideration. For good or ill, democracy is the prevalent form of government, and, as Dr. Little says

"An electorate, which regards itself as free, listens to the broadcast noise of manufactured demonstrations and is blind to the obvious mechanics of synthetic bedlam The result is too often government by gullibility, propaganda, catchwords, and slogans, instead of government by law based on facts, principles, intelligence, and good will."

These are the conditions which result in the appointment of our leaders, and we may take it that the fittest survive It is not likely that the men who can swim successfully through this welter will have much knowledge of, or reverence for, the scientific attitude of mind It is too much to expect that they will demonstrate to the whole world their own incompetence by handing over their business to larger and better-trained intelligences. Once more, what is required is a higher cultural level on the part of the public, a general recognition of the value of the scientific mind in all departments of public life But here we are hampered by the fact that we have no clear evidence that the majority of scientific men would be of any particular use in the conduct of affairs It is not wise to make claims that cannot be substantiated, and the views of scientific men, taken as a whole, on political questions seem indistinguishable from the views of an equal number of ordinary citizens With the majority of scientific men their habit of cautious weighing of evidence, their ingenuity in reducing a problem to its essentials, their lack of prejudice in coming to results, do not noticeably extend to their political opinions They read newspapers as uncritically as does any other kind of educated man, and far more uncritically than the most insignificant Fleet Street journalist. There is no evidence that the views of the Royal Society on international politics are worthy of any special consideration

While, however, it is true that scientific men, as a whole, rank with the rest of the community in these questions, it may be that there are branches of science in existence which could make valuable contributions to the actual problems of government This is obviously true of problems which involve technical processes A general scheme of electrification, for example, should obviously be committed to men of science Questions concerned with national defence, also, should be, and largely are, in the hands of scientific men But Dr Little thinks that men of science could make still more fundamental contributions He refers us to psychology, and apparently thinks that its findings could already be profitably applied to the general problems of government This may be true, although it seems likely that the science of psychology should be further developed before any body of legislators should be encouraged to attempt striking improvements by its aid Undoubtedly science can already furnish much besides "practical applications," but chiefly, we suggest, in giving problems a new orientation and by suggesting new methods of attacking them.

There is another aspect of the general question, an aspect that Dr. Little has not touched upon Granted that some scientific men possess great administrative ability and that they could play a very effective part in solving problems now left to the politicians, do we want to use our scientific men as administrators? In the United States they are already employed in that way to a greater extent than is customary in Europe, but whatever the benefit to the American community, it is not clear that science in the United States has benefited by it

Mr Bertrand Russell has recently given it as his opinion that, in the United States, Einstein would probably have been made the administrator of a large university and, as a consequence, would never have had the leisure necessary to develop his generalised theory of relativity Would that have been a gain? Was it a gain that Newton should have become an industrious and conscientious Master of the Mint, seeing that he produced no more original work in science for the rest of his life? Newton's work in science certainly saved the labours of two or three generations of scientific men It is difficult to say when the theory of relativity would have been hit upon if Einstein had devoted his time to other things

It is not at all clear that a scientific man, as soon as he has proved himself to be of great value to science, should be immediately called upon to do something else, even though the something else should be of more immediate practical utility. Dr. Little informs us that American men of science are not in Congress Well, they are presumably in their laboratories, which may ultimately be a better thing for the world Nevertheless, it is desirable that so valuable a group should have a means of making the weight of its opinions effective in government

The true issue is that the scientific contribution should be worthily employed It should no longer be left to random and sometimes base exploitation. This means that scientific men must come into the arena, and take a greater part than they have yet taken in impressing their ideals, as well as their ideas, on the public. It would not be a bad thing if scientific men developed a "class-consciousness." If scientific ideals are to gain any hold on the community it must be by vigorous propaganda, not by annual laments at the paucity of government grants. There should be lecturing campaigns and periodicals devoted solely to this end As it is, the writers quoted by Dr Little are able to say, with some show of justice, that science touches only the fringe of life, that it has no bearing on the centre of life at all. In a democracy one must appeal to the people Science has a spirit as well as a body, and it is its spirit, even more than its body, which is the potential saviour of mankind.

The Study of Crystals.

(1) *X-rays and Crystal Structure* By Sir W H Bragg and Prof. W. L Bragg Fourth edition, revised and enlarged Pp xi + 322 + 8 plates (London G Bell and Sons, Ltd, 1924) 21*s* net

(2) *The Structure of Crystals* By Ralph W G Wyckoff (American Chemical Society Monograph Series) Pp 462 (New York The Chemical Catalog Co, Inc, 1924) 6 dollars

(3) *Chemische Kristallographie der Flussigkeiten Kurze Anleitung zur Synthese und Untersuchung polymorpher und kristallin-flussiger Substanzen* Von Prof Dr D. Vorlander Pp 90 + 30 Tafeln (Leipzig Akademische Verlagsgesellschaft m b H, 1924) 12 marks

IT is only about twelve years ago since the study of the crystalline state was the most neglected of all the branches of physical chemistry, so much so that a student who was full of learning about ions and about osmotic pressure would probably be unable to define a centre of symmetry or to describe the meaning of hemihedrism, unless he happened incidentally to have been also a student of mineralogy The marvellous changes which have taken place in recent years have been due almost exclusively to the new methods of studying crystals by means of X-rays, which were discovered by Laue in 1912, and developed without delay by the Braggs. Some fifty-seven papers on the subject were already published in the year 1913, and it was only the diversion of scientific energy to other ends during the War period that kept the output for several years below thirty papers per annum Since then, as Dr Wyckoff's bibliography shows, the output has increased to such an extent that on the average two new papers on the subject are now being issued every week

(1) In the midst of all this activity it is only fitting that a fourth revised and enlarged edition of the book on "X-rays and Crystal Structure," first issued in January 1915, should appear. It is remarkable that, in spite of the great developments that have taken place, this book still retains the charming simplicity of style which enables Sir William Bragg in his lectures to persuade even the simple and the unlearned that learning is both possible and pleasant, even when the subject to be learnt is the science of crystallography The contents of the book are, however, changed almost beyond recognition, not merely by the inclusion of new matter, but also by the introduction of new types of investigation. Foremost amongst these is the application of X-rays to the study of the structure of organic crystals, where the method only indicates directly the spacing and orientation of the *molecules*, leaving the positions of the *atoms* to be deduced from a blending of stereochemistry with crystallography In this difficult field caution is obviously needed, but not that type of caution which leads to pessimism, or to a refusal to undertake experimental investigations on the ground that the methods available are wholly inadequate to the task It is, however, in strict agreement with the facts of chemistry that Bragg regards the diamond as the prototype of all saturated carbon compounds of the "aliphatic" series and "graphite" as a prototype of the bewildering "aromatic" series, where a latent unsaturation lies concealed beneath a superficial appearance of saturation, like a bankrupt hiding his financial necessities from all but his most intimate friends

Having thus secured, by the X-ray analysis of diamond and of graphite, a direct foothold in carbon-chemistry, Sir William Bragg and his colleagues have attacked a series of problems of increasing difficulty, and if the results of their investigations have not the same adamantine certainty as in the case of the elements and their simplest compounds, they have been in the highest degree useful to chemists, stimulating them into activity of thought and investigation by means of new conceptions of "chemistry in space," and by the presentation of new problems It is indeed refreshing to see elementary sulphur treated with the organic compounds and to realise that it has after all most of the characteristics of such compounds, and to see the familiar tetrahedral model of the carbon atom used, with a sound basis of experimental fact, to explain the arrangement of the silicon atoms in quartz Chemists would be ungrateful if they failed to welcome such intrusions from the most helpful and sympathetic amongst their physical colleagues

(2) Dr Wyckoff's book, although addressed to chemists, as one of a series of monographs prepared for their edification at the request of the American Chemical Society, is much inferior in its power of appeal, since no attempt is made to present the story in an easy or simplified form Even on the first page the reader is presented with a definition of a screw axis of symmetry, of which the familiar rotational axis is treated as a special case, in direct opposition to the humane method of teaching which consists in leading up from the known to the unknown, and already on the fifth page he finds himself entering a thick forest of point groups, beginning with "Point group 1C (C_1) [Hemihedral class]" No apology is therefore needed for the statement that the book would be hard reading for a chemist who had already studied crystallography, or for the advice that a reader who is ignorant of crystallography would do well to buy an introductory text-book on the subject, and master it before tackling

Dr Wyckoff's monograph The book is, in fact, suitable as a guide to a research worker taking up the study of the subject, and it will be welcomed by the more mature workers in this field on account of the complete bibliography which it contains, but it is quite unsuitable for the general reader, who would find it more profitable to allow the Braggs to explain to him the methods and results of the new processes of analysis

This does not mean that the book is of no value to the chemist, but rather that he must chew hard in order to extract small scraps of nourishment from this very strong meat Thus it is interesting to be told that in the alums "three of the oxygen atoms in the sulphate group are geometrically alike but different from the fourth, and that the water molecules fall into two groups of six each," since this agrees with the distribution that one would picture in a double sulphate of a univalent and a tervalent metal Still more fascinating is the statement that, in the ammonia alums, the only arrangement of the four hydrogen atoms which is consistent with the crystal symmetry is a linear one with a nitrogen atom in the centre of two pairs of hydrogens Since this is chemically improbable (not to say impossible), it is suggested that "the ammonium group functions crystallographically as well as chemically as a single entity, and that its hydrogen atoms need not therefore occupy positions which conform to the demands of the crystal symmetry This hypothesis probably cannot be directly tested either optically or with X-rays because it is unlikely that the hydrogen nuclei are centres of electron motions" (p 363) It is, however, noteworthy that, in Morgan and Bragg's analysis of the crystal structure of basic beryllium acetate, the univalent methyl groups are placed with their carbon-to-carbon bonds in the line of the axes of *two-fold* symmetry, in spite of the fact that the three hydrogens of the methyl group demand instead an axis of *three-fold* symmetry It looks, therefore, as if, in the theory of crystal structure, hydrogen again occupies an unique position, and requires to be treated differently from all other elements

Dr Wyckoff devotes a chapter to "Incomplete Crystalline and Non-crystalline Diffraction Phenomena," in the course of which he refers to the so-called "liquid crystals" It is now clear that these queer anisotropic liquids cannot be assigned to any known or theoretically possible class of crystals, but since they also have been subjected to analysis by X-rays, it will not be entirely out of place to include in this review a brief notice of a monograph of ninety pages by Prof Vorlander (3), whose name has been associated, during a period of nearly twenty years, with work on the chemical aspects of this fascinating subject So long ago as 1906–7, Vorlander showed the importance of a linear structure of the molecule for the development of anisotropy in the liquid state, and proved that in derivatives of benzene the substituents must be in the *para* position in order to produce this effect, which disappears in the case of the isomeric *ortho* and *meta* compounds

The present monograph, under the somewhat misleading title of "Chemical Crystallography of Liquids," proceeds along similar lines, the fundamental proposition that anisotropy in liquids implies a linear molecular structure being applied as a test of the molecular form of a large variety of compounds. It is shown, for example, that where a normal propyl and a normal butyl derivative of *p*-azoxycinnamic acid have a range of stability in the anisotropic state of 112° and 103° respectively, the *iso*-propyl and *iso*-amyl derivatives, with branched chains, have a range of only 35° and 42° respectively It is, therefore, definite evidence of the zigzagging of a hydrocarbon chain that a single CH_2 group between two aromatic nuclei prevents the development of anisotropy in the liquid, whereas this phenomenon is developed strongly when there are two CH_2 groups, and appears again in a less striking degree when the number of CH_2 groups is increased to four Since the author claims to have laid down rules which have led to the preparation of 2000 compounds of this type, he is obviously in a very good position to discuss the origin of the phenomenon It is also desirable to direct attention to the exceptional skill which the author has shown in securing photographic reproductions (unfortunately only in black and white) of his observations This skill was already manifest in his earliest papers in the *Zeitschrift fur physikalische Chemie*, and he has certainly not lost it in the intervening years, since the monograph now under review includes a series of sixty-one beautiful photomicrographs, which would by themselves fully justify the purchase of the book

T M. LOWRY

Sexuality and Hormones.

Sexualité et hormones les caractères sexuels considérés comme phénomènes de développement et dans leurs rapports avec l'hormone sexuelle. Par Prof Ch. Champy Pp 376 + 7 planches. (Paris: Gaston Doin, 1924) 30 francs

PROF CHAMPY is one of the most versatile and rapid of biological workers Tissue-culture, amphibian metamorphosis, the mode of action of hormones, the theory of sex, growth;—he has touched on and illuminated all these fields within the last few years In the present volume he presents a thesis, based on various aspects of this work, which

is of considerable importance. Perhaps the best way to show its importance will be to set down a series of the established facts on which it is based, letting them tell their own story, and then criticising some of the more theoretical part of Champy's interpretation.

As everybody knows, the majority of secondary sexual epigamic characters arise in development by the more rapid growth, at one period or other, of some rudiment common to both sexes This may take place once and for all. or regress and recur seasonally Some years ago Pézard very thoroughly analysed the influence of the testis upon the growth of the fowl's comb, and found that whereas the comb of the capon grew proportionately to the rest of the body, that of the bird possessing a testis grew disproportionately The former type of growth he christened *isogonic,* the latter *heterogonic* After a certain period of heterogonic growth, however, equilibrium is attained, and growth becomes again isogonic, but at a new level.

In various lower forms of life, however, heterogonic growth continues permanently This is true, for example, for the claws of male fiddler-crabs Thus, the large male fiddler has, not only absolutely, but also relatively, larger claws than the small one. Here, by the way, the morphologist meets with a stumbling-block. The male fiddler-crab has *no* fixed form Its form, in respect of the proportions of its parts, is only a function of its absolute size

Next point: in many insects, in spite of the fact that no moulting or growth occurs after the imago stage is reached, a similar phenomenon is found; the absolutely larger individuals possess relatively larger sexual characters This is true of the ordinary male stag-beetle, and to a remarkable degree of the Hercules and Goliath beetles Champy rightly concludes, like his predecessors, that the definitive visible effect is due to a continuous process of growth—the accumulation at a heterogonic rate of some substance responsible for the production of the particular organ

Secondary sexual characters, however, are not the only ones to show heterogonic growth That is also found, for example, in the limbs of frog-tadpoles, and here, further, the rate of growth is quantitatively related to the amount of thyroid hormone present.

Then, as Lameere in France, and Geoffrey Smith in England, pointed out, the phenomenon extends beyond the limits of the single species Within a group such as the stag-beetles, the larger *species* on the whole have relatively larger sexual characters than the smaller

Here we clearly have a mechanistic explanation of much of "orthogenetic" evolution Granted this particular mode of development for certain organs in a given group, then these organs will tend to become relatively larger in larger species, unless counter-measures are taken. If the course of phylogenetic evolution of the group happens to have run from small to large size, then the organs in question will show an apparently determinate evolution, although the only determinism will, as a matter of fact, be that involved in the single type of developmental machinery possessed by the whole group This appears actually to have occurred among mammals with the horns of the Titanotheres and the antlers of the Cervidæ

Champy also points out that the details of the heterogonic organ are usually specific, varying from species to species, while, on the other hand, the type of growth is common to all members of the group This would imply a fundamental growth mechanism, with different individual genes embroidering the resultant organ in various ways in various species. There is also the fact that highly adaptive sexual characters, such as certain copulatory organs, ovipositors, etc, do not show heterogony, but are of fixed relative size. This we take as an adaptation, in that size-variation would interfere with nicely specialised function

Finally, the author gives the results of some interesting experiments he has made on the growth of seasonally recurrent secondary sex-characters in Amphibia in relation to their nutritive condition. In brief, he introduces us to the following conception for organs like the glands in the male frog's thumb-pad, or the crest of male newts, there are two limiting factors involved—first, the testis-hormone; secondly, the nutritive condition of the animal. The hormone is necessary for the appearance of the organ, but is efficacious even in very small quantities (*e g* when produced by small regenerated nodules of testes after attempted castration), anything above a small threshold-value exerts a constant influence The actual effect produced when excess gonad-hormone is present, however, depends on the excess of nutriment present Very fat frogs with a bare minimum of testes retain thumb-glands of maximal size, while unoperated but emaciated frogs show great reduction of the glands, which are sometimes not to be distinguished from those of full castrates In practice, therefore, nutritive condition is the effective limiting factor These considerations, as Champy justly points out, vitiate many of the castration experiments that have been carried out on amphibians

As regards general considerations, it remains to mention two points not touched on by Champy. One concerns the quantitative side of heterogonic growth. Champy gives here some suggestive figures, but far too few to establish any assured law of growth The reviewer has recently taken the matter up in fiddler-

crabs, and finds that, if y = weight of the male's large chela, w = total weight of the crab, then $\log y = \log b + k \log (w - y)$, where $k > 1$.[1] This gives us a first firm step into the details of the process.

In the second place, there is the whole problem of what we may call *minus-heterogony*. In the cases which have so far been considered, we have *plus-heterogony*—organs grow faster than the body as a whole. But if the growth-rate of an organ were slower than that of the rest of the body, it would become relatively smaller as the animal becomes bigger. Very little attention has been paid to this problem. There seems, however, little doubt that the "degeneration" of the male elements in the female accessory reproductive system, and vice versa, will be found to be not a phenomenon of true degeneration, but of depressed relative growth-rate. It is usually not realised what an enormous difference in end-result is accomplished by a small but constant difference in relative growth-rate. In the fiddler-crabs above cited, the male chela grows about $1\frac{1}{2}$ times as fast as the rest of the body, and increases from 2 to 65 per cent of the weight of the rest of the body during growth to a total weight of only $3\frac{1}{2}$ grams. With a growth-rate of two-thirds the rest of the body, an organ would be negligibly small in a mammal weighing 100 grams at birth. The same is probably true of very many vestigial organs, which would account for their rudiments usually being relatively much larger in the embryo than in the adult. Putting it in another way, we may say that the biologically simplest way of altering the relative size of an organ in the adult seems to be by altering its relative growth-rate during development. The study of quantitative relations during development will thus develop into one of the keystones of biology, throwing light both upon the mode of action of genetic factors and upon the appearance of adult characters. It will stand in the same relation to morphology as does physical chemistry to ordinary inorganic chemistry.

We may conclude by a few detailed criticisms. Prof. Champy has given us that irritating thing, a book without an index. That is a vice more prevalent in France than in Britain; but custom does not make it any more excusable. He has unaccountably failed to make any reference to Geoffrey Smith, whose work, published so long ago as 1905, was one of the earliest and most penetrating contributions to the subject of heterogonic growth. He states that he has been unable to find any case of heterogony in a female secondary sex-character—a statement later qualified in the postscript, where he mentions the elytra of the females of two genera of beetles. The type of growth is, however, common in crabs, where it appears to be universal for the abdomen and abdominal appendages of the females. As regards another point, there seems no reason for abandoning Pézard's term *heterogonic* and substituting *disharmonic* for this type of growth.

The drawings are often rather sketchy, and some of the series of insects not quite so convincing as one would wish; while the section on the respective rôles of spermatogenic and interstitial tissues in producing the testicular hormone has no real connexion with the rest of the book.

However, there is no doubt that the book is extremely stimulating, and presents a large number of facts, many of them new, in a way which should excite interest and promote research in an almost untouched and very important field of biology. We have no hesitation in recommending it to the notice of systematists, morphologists, and experimenters alike.

J. S. H.

[1] See NATURE, December 20, p. 895.

The Biology of Plants.

The Biology of Flowering Plants. By Dr. Macgregor Skene. (Biological Handbooks Series.) Pp. xi+523 +8 plates. (London: Sidgwick and Jackson, Ltd., 1924.) 16s. net.

THE title of Dr. Skene's book can be interpreted in various ways and, at its widest, would embrace the entire field of botany; this could only be dealt with in the most superficial manner in the compass of a single book. Here, however, Dr. Skene has restricted himself to a consideration of the relation of the individual to its environment in the sense usually connoted by the term autecology, more particularly as regards those aspects which might be included under applied physiology. In his treatment the author has succeeded in incorporating much of the physiological work of recent years, and in a very readable manner points to its bearing on the life of the plant in Nature. The exposition is in general clear, and if the author has at times failed to steer a middle course between the Scylla of technical expression and the Charybdis of obscurity, he has at least avoided the shoals of ambiguity and misconception.

An elementary account of the soil and its function in relation to the supply of water and mineral salts is the occasion of reference to recent work on the hydrogen-ion concentration of the soil solution, the work of Weaver, Cannon, and others on root systems, and a much too brief reference to the soil organisms. The chapter on assimilation and transpiration rightly occupies a considerable section of the book. The present position of our knowledge respecting the function and regulatory action of the stomata is clearly

summarised There can, indeed, be little doubt that the *primary* function of the stomata is not the regulation of the passage of water vapour but of the gaseous exchanges involved in respiration and assimilation This is well shown by the fact that stomatal movement is chiefly determined by changes in illumination and by the observations of Lloyd that the maximum aperture of the stomata is maintained between 8 A M and 1 P M, whereas the maximum period of transpiration begins two hours later and ends an hour earlier The high osmotic pressure attained by the guard cells in bright light probably ensures their maximum efficiency at a time when the demand for carbon dioxide is greatest, but also involves the well-known fact that the stomata may remain open whilst the rate of transpiration is excessive and the leaf actually wilts As automatic checks to transpiration the stomata may then fail just when most needed

The account of assimilation deals with the conditions governing the process, particularly with the results of Blackman, Willstatter and Stoll, Lundegardh, Briggs, and so on In this connexion one may perhaps demur to the acceptance of Lundegardh's interpretation that shade leaves are less efficient in respect of diffusion than sun leaves, since the results he obtained are more probably due to the more efficient use of radiant energy by the shade leaf than the sun leaf Comparisons on the basis of leaf area are manifestly misleading, but those in which equal weights of fresh leaf have been compared show that shade leaves are often much more efficient than sun leaves in low intensities of light and slightly so in bright light These results, even allowing for the difference in respiration rates, are scarcely compatible with Lundegardh's assumption of slower diffusion in the shade leaf The mechanism is possibly connected with the higher proportion of green pigments which the chlorophyll of shade leaves contains and in many cases to a higher chlorophyll content, but other factors are probably involved of which we are at present ignorant

The succeeding chapter treats of the special modes of nutrition as exemplified in saprophytism, parasitism, and the various mycorhizal relations This is followed by an account of the mechanical requirements of plants as shown by their gross anatomical features and morphological modifications. Reproduction and methods of dispersal, which form the subject of the next chapter, and development, which is the final section, scarcely receive adequate treatment The work concludes with a bibliography of more than six hundred titles of papers cited in the text, and two indices which might more conveniently have been combined

In a work covering so large a field the treatment is naturally uneven The subject of galls, for example, is dismissed in half a page, whilst seed dispersal occupies barely ten pages of type, and the author is clearly more at home in the physiological than in the more morphological aspects of his subject The pages are nevertheless full of interest, and it is certainly a book which students will find most helpful as indicating the trend of certain aspects of modern botanical thought

E J SALISBURY

Our Bookshelf.

The Romance of Plant Hunting By Capt F Kingdon Ward Pp xi + 275 + 8 plates (London E Arnold and Co, 1924) 12*s* 6*d* net.

CAPTAIN KINGDON WARD has written a book of considerable interest both to the lover of plants and also to the geographer and traveller, since he is able to show not only the interest which attaches to plant collecting, but also the many difficulties which the good plant collector must overcome in order to be successful Botanists and keen gardeners are likely to be more interested in his book than the public at large since he naturally has to refer to so many plants by their Latin names The general reader, however, is amply compensated by the fine set of pictures both of general scenes and particular plants with which the book is illustrated

The volume is the outcome of three separate journeys in China before the War and of three undertaken during 1919, 1921–22, though the last is the one most drawn upon in the narrative There is a good map at the end of the volume which enables the reader to follow the author in his wanderings Those who have received seeds collected by Capt Kingdon Ward realise that he is a really good collector as his seeds have germinated with remarkable success and he also has the keen eye for plants of interest Whether they may happen to be " first class " in the idea of the nurseryman or not, they are certainly of value to the botanist

Capt Kingdon Ward tries to pretend he is not a botanist and in some ways perhaps he is not but his early training at Cambridge, with which the writer had something to do, and his inherited tastes from his distinguished father, have given him a love for flowers and a keen interest in the remarkable play on form and structure to be met with in the vegetable kingdom. With the author's second chapter we are not wholly in accord and one would have wished that some things in it had been omitted, but this does not detract from the really interesting and, as he rightly terms it, the romantic side of plant collecting

The chapters when the author is on the march must be read in full to be appreciated, and no review can cover the ground sufficiently to make the reading of the book unnecessary There is much to be found in the pages beyond the mere hunting for special plants, and much of value is recorded as to the geology and geography of the regions visited. Capt Kingdon Ward is a true naturalist and very little escapes his keen eye The book is enlivened by interesting particulars about the various peoples with whom he came in contact;

nor is the humorous side of his travelling experiences forgotten, though no doubt at the time the humour was not always evident We feel sure that when the good plants introduced by Capt Kingdon Ward become better known, his name will rank high in the list of distinguished plant collectors to whom British horticulture owes so much.

Light and Sound a Text-book for Colleges and Technical Schools By Prof William S Franklin and Prof Barry MacNutt Pp vi+310 (Lancaster, Pa · Franklin and Charles, London Constable and Co, Ltd, 1924) 5*s*. net

Electricity and Magnetism a Text-book for Colleges and Technical Schools By Prof William S Franklin and Prof Barry MacNutt Pp xvi+294 (Lancaster, Pa Franklin and Charles, London Constable and Co, Ltd, 1924) 5*s* net

The two volumes under notice are revised versions of previous editions, and are said to be suitable "for colleges and technical schools" As regards scope it is somewhat difficult to place them, for according to English standards it is curiously uneven There are many excursions into topics of a more advanced character than is usual in books of this size (and price), but the treatment is mainly non-mathematical, and has a strong practical or engineering flavour Nevertheless, it is usually so lucid as to repay perusal by the average "pure science" student The sections dealing with lens imperfections and alternating current are particularly good On the other hand, the methods given for simple lens calculations might be expected to drive even the engineering student, for whose benefit they have presumably been "simplified," to graphical methods for safety On the whole, however, if the general viewpoint is acceptable, there will be little to criticise in matters of detail, which are usually accurate and up-to-date An exception, albeit a trifling one, is the statement that "the most accurate wave-length measurements are made by means of the Michelson interferometer" To the English reader the frequent occurrence of such units as "abohms," "stathenries," and the like will at first be a little disquieting, but he may eventually find in their obvious convenience some compensation for their exotic appearance

Le Volvox Par Charles Janet Troisième mémoire: *Ontogénèse de la blastéa volvocéenne* Première partie Pp 179+planches 5-21 (Macon Protat frères, 1923) n p

In this third memoir M Janet approaches the problem of the ontogenesis of the Volvox blastea (cœnobium) He confines himself to the methods of cell bipartition, but in later works he proposes to discuss variations in the process and special cases The memoir is an able attack on an exceedingly intricate and difficult problem and contains a wealth of minute detail The author starts by pointing out the primitiveness of the Volvox cell and how, in his opinion, these blasteas are in large measure representative of the primitive animal cell groups He then goes on to describe the apparatus by means of which he separates out the minute organisms, and having pointed out the fundamental units of the cell he considers the homologies between the blasteas of plants and animals Thereafter he examines the divisions of the cells of *Janetosphæra aurea* (Ehrbg) Shaw, in greater detail It can be well understood that in such an involved study a comprehensive scheme of terms is required, these the author has supplied as well as formulæ for expressing symbolically the type of generation and the mode of reproduction of the organism under study Assisted by 21 excellent plates containing many figures and diagrams, he traces the various divisions and shows that after bipartitions resulting in 1024 cells, the cells of *J aurea*, having reached their minimum limits and used up all available reserves, cease to divide and enter into a new phase—the flagellate stage Throughout, the work is one where questions regarding evolution in the plant world are always kept to the front, for the author's knowledge of plant and animal life permits him to make useful comparisons

A Text-Book of Inorganic Chemistry Edited by Dr J Newton Friend (Griffin's Scientific Text-Books) Vol 2 *The Alkali-Metals and their Congeners* By Dr A Jamieson Walker Pp xxvi+379 20*s* net. Vol 7, Part 1 *Oxygen* By Dr J Newton Friend and Dr Douglas F. Twiss Pp xxvi+370 18*s* net (London C Griffin and Co, Ltd, 1924)

The two new sections of Dr Friend's "Inorganic Chemistry" deal with (1) hydrogen, the alkali metals, the ammonium-compounds, and the coinage-group of metals, and (2) oxygen, water, and hydrogen peroxide The style of the book is now so well established, and so well known, that it is difficult to comment usefully on the individual sections as they appear The parts now issued appear to be very complete in the information supplied, and the expansion of the section on oxygen to a volume of 350 pages has made it possible to include a much larger number of analytical data than it is now fashionable to quote in a text-book, as well as to deal in unusual fulness with modern work on combustion By contrast, the volume on the metals of Group I appears to be somewhat abbreviated, since the three metals of the coinage-group are disposed of in little more than 100 pages Illustrations are also used less freely, being limited to a few solubility diagrams, etc, and two line-drawings, thirteen in all The section on oxygen, on the other hand, is illustrated with some fifty diagrams, and a full-page plate showing the photographs by Burgess and Wheeler of flames near the lower limit of inflammation of methane in air The homologues of oxygen (sulphur, selenium, and tellurium) are postponed to a later section of Vol VII, whilst the remaining elements of Group VI will form a separate Part III.

Venereal Disease its Prevention, Symptoms and Treatment By Hugh Wansey Bayly Second edition. Pp xvii+176. (London: J and A Churchill, 1924) 7*s* 6*d*. net

Venereal disease, like all infectious maladies, is to be considered from two aspects, those of prevention and treatment. The importance of the former certainly has full recognition in Dr Wansey Bayly's book, the preface of which is devoted mainly to a defence of the policy of the Society for the Prevention of Venereal Disease In the first section of the book the author

puts forward a scheme whereby he considers that syphilis could be almost entirely eliminated in a generation. Briefly, it consists in compulsory notification to a special Medical Officer of Health, who visits the victim, ascertains from whom the disease was contracted, and traces that individual Infected persons are given the choice between treatment at a hospital and attendance on a physician of their own selection Heavy penalties are attached to the doctor who fails to notify, and to the individual who conveys disease to another before being certified free from infection Such a scheme might, however, defeat its own ends by driving the patient to abstain from treatment altogether or to obtain it secretly and illicitly at the hands of quacks

The sections on symptoms and treatment, which comprise the greater part of the book, are clear, concise and fully up-to-date For the student and general practitioner who have not the time to devote to large text-books, there could not be a better guide

Abridged Scientific Publications from the Research Laboratory of the Eastman Kodak Company Vol 6. 1922. Pp 238+vii (Rochester, N Y Eastman Kodak Co, 1923) n p

OWING to the increasing number of communications from the Eastman Kodak Laboratory, it has been decided to issue a volume of abridgments every year The present volume deals with the papers that were published in 1922, many of which were referred to in our columns when they first appeared These abridgments are not mere statements of the subjects dealt with, but are the papers themselves, shortened somewhat by the omission of some of the details that are not necessary to the understanding of the work done and its results Those specially interested will naturally consult the original publication for fuller particulars and especially for more complete data The 30 papers included in the volume are classified under the headings of physical and photographic optics, inorganic, organic, physical, and colloid chemistry; photographic theory, and practical photography The character of the work done is now so well known that it is not necessary to enlarge upon it, except to say that several new instruments are described that have been constructed to enable investigations to be carried further than has hitherto been possible.

The Amphibia of the Indo-Australian Archipelago By Prof Dr P. N. van Kampen. Pp xii+304 (Leyden E J Brill, Ltd, 1923) n p.

THE Malay Archipelago, consisting as it does of a large number of islands separated in many cases from one another by very deep sea, has yielded many very interesting problems in the science of the geographical distribution of animals Nothing perhaps could afford more useful information in the attempt to solve these problems than a thorough knowledge of that essentially terrestrial and freshwater group, the Amphibia.

Prof van Kampen, of the University of Leyden, has therefore rendered great service by preparing for the use of students a critical study of the 254 species that are known to occur in the Dutch archipelago together with New Guinea, the Bismarck archipelago and the Solomon Islands The descriptions of the species are mainly technical in character, but so far as possible an account of the tadpoles and some notes on habit are included There is a useful synopsis of characters at the head of each family and genus, and there are a few excellent illustrations

Ophthalmo-Optical Manual By William Swaine Pp v+152 (London The Hatton Press, Ltd, n d) 5s net

WE welcome the appearance of this little volume, because there is a real need for a practical handbook on the main essentials of sight-testing In this book the subject is treated in a scientific manner seldom adopted in text-books of this nature The more recent developments of sight-testing are considered, of particular interest are the corrections required to flat trial-case refraction values when toric and similar lenses are to be used This was first pointed out by the author and is as yet scarcely appreciated by the average optician The unit planes of such lenses are in quite different positions (relative to the eye) from those of the standard trial case lens, and consequently the refraction values for such lenses have to be materially altered In addition a number of very useful tables have been included, and these, together with an exhaustive index, make it a valuable reference book

Warley Garden in Spring and Summer By Ellen Willmott Second edition. Pp ii+41 plates (London Wheldon and Wesley, Ltd, 1924) 10s. 6d net

THIS series of beautiful pictures of a famous garden would have been of some general interest had they been accompanied by a plan of the Warley Garden and some particulars about the plants that are in cultivation there As it is, they are merely a collection of pictures, some of which are of no great merit Among the best are the Alpine primroses, Plate 5, and the Nankeen lilies, Plate 31, but had the actual names of the plants depicted been given, in these and other cases, the volume would have been of far greater value to those interested in gardens

It is to be regretted that a garden, which has so much charm and is owned by a lady who is so fitted to describe it, is merely illustrated in this series of pictures and all that is of real value is left unrecorded

Unscientific Essays By Prof Frederic Wood Jones Pp 208 (London E. Arnold and Co, 1924.) 6s net

A MAN is largely known to his friends by his hobbies, and clearly our author's hobby is to sit and reflect, occasionally feeling himself stimulated to jot down what he feels or has seen He has a broad experience of the wild, both on sea and land, almost unexplored coral reefs of Malay and deserts of Australia He liked the natives with whom he came into contact, and frequently he has blended folk-lore into his themes, this being perhaps the most interesting feature of his book He tells us the crab's secret, and of course he caught a sea-serpent, his account of which we first saw repeated in the daily press with references to his official position as a professor of anatomy. As such, journalists apparently supposed him to have no lighter moments, his essays are just the thing for our ease

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Effective Wave-lengths of γ-Rays.

ONE of the difficulties in explaining the results of experiments on γ-rays is our lack of knowledge of the variation of intensity with wave-length in the spectrum of the γ-rays. This has led to the use of "effective" wave-lengths (two, in general, being needed because scattering and absorption coefficients vary with the wave-lengths in different manners), and values have been used, which, although incorrect, apparently help to explain the experimental results. For example, I have pointed out at two scientific meetings (American Physical Society, December 1922, and the British Association, Toronto, August 1924), that if we assume, as has been done by several physicists, that the effective wave-length of the γ-rays is about 0.02 Å.U., the secondary β-rays produced in light elements by the hard γ-rays of radium-C possess far too much energy to be recoil electrons (for the properties of which see a paper by Compton and Hubbard, *Physical Review*, 4, p. 439, 1924). Experimental evidence indicates that these β-rays are not photoelectrons. If they are recoil electrons, the effective wave-length of the γ-rays must be taken as about 0.008 Å.U. in order that we may account, on the quantum theory of scattering, for their observed energy. This result, which was first obtained by a comparison of the relative penetrating powers of the secondary β-rays and the β-rays of radium-E, has led, among other things, to a consideration of the following questions.

1. What proportion of the atoms of an element emitting one or more types of monochromatic γ-rays contributes, on disintegration, to such γ-rays ?
2. Is a knowledge of the wave-lengths and relative intensities of the lines in the spectrum of γ-rays sufficient to enable us to determine effective wave-lengths and, with theoretical aid, to interpret the results of scattering and absorption experiments ?
3. Is the energy of the secondary β-rays which have been called recoil electrons greater than that given by the quantum theory of scattering ?
4. Are the γ-rays of thorium-D always more penetrating than those of radium-C, no matter what the thickness of the absorbing material used ?

I am not prepared to answer questions 3 and 4 and cannot give a complete answer to the other two. The simplest case to examine is radium-D. In the course of his fundamental experiments on the line spectra of γ-rays, Ellis (Proc. Camb. Phil. Soc. 21, p. 121, 1922) has shown that radium-D probably emits "hard" γ-rays of wave-length 0.264 Å.U., part of these rays being absorbed in producing the L and M spectra of radium-D, the "soft" rays, of average wave-length 1.06 Å.U. By a comparison of the total ionisations they produce, I find that the energy of the soft rays $=\frac{1}{2}$ that of the hard rays, and as the energy of a hard ray $=1.06/0.264$ or 4 times that of a soft ray (if such expressions may be used), it follows that out of every three hard rays emitted by the nuclei of radium-D atoms, two are absorbed in the atoms in which they are produced. The internal atomic absorption coefficient of the hard rays, assuming them to produce the soft rays in the way mentioned, is therefore 0.67 as compared with an external coefficient of about 3×10^{-21}. Ellis and Skinner have directed attention to the very high values of these internal absorption coefficients. It may be worth while pointing out, in connexion with experiments on the scattering of X-rays, that such a high internal coefficient of absorption is not observed with β-rays.

The energy of the unabsorbed hard γ-rays has been found by ionisation measurements to be 1/150 that of the β-rays of radium-E in equilibrium with the radium-D. Taking the average energy of such a β-ray to correspond to 467,000 volts, of a hard γ-ray to 46,700 volts, a simple calculation shows that only one in every five radium-D atoms emits a γ-ray on disintegration. Radium-D apparently does not emit "white" γ-rays or rays which give a continuous spectrum and so we have fairly complete knowledge about it, but this is not the case with most of the other elements emitting γ-rays.

In a recent paper, Ellis (Proc. Camb. Phil. Soc. 22, p. 369, 1924) publishes a table giving some of the lines in the spectrum of the hard γ-rays of radium-C, extending from 0.0453 Å.U. to 0.00557 Å.U. What appears to be the most intense line has a wave-length 0.00867 Å.U., a value not very far from that given above. Such tables, however, even if we knew the relative intensities of the lines, do not enable us to find effective wave-lengths of γ-rays, unless we are certain that only a negligible proportion of the radiation is white. That a large part of the γ-radiation of thorium-D is white, is indicated by the following evidence, to which Ellis (Roy. Soc. Proc. A, 101, p. 1, 1922) has directed attention. The lowest wave-length found by him so far in the line spectrum of these rays is about 0.014 Å.U., and yet they should have a lower average wave-length than the γ-rays of radium-C, as they are more penetrating (see question 4 above), hence the probability of white radiation of very small average wave-length. In the case of radium-C there is not sufficient evidence, so far as I am aware of it, to come to a definite conclusion about the presence or otherwise of white radiation. The following results have been arrived at.

1. If the secondary β-rays, produced in light elements by the hard γ-rays of radium-C, are recoil electrons, with energy given by the quantum theory of scattering (see question 1 above), the effective wave-length of the γ-rays must be much smaller than that usually accepted. Without going into details, I may state that one can prove from this result that no theory, as at present developed, can account for the properties of scattered γ-radiation.
2. With certain reasonable assumptions, it has been found that the internal atomic absorption coefficient of the hard γ-rays of radium-D is 0.67 as compared with an external coefficient of about 3×10^{-21}, and that on disintegrating, one out of every five atoms of radium-D emits a γ-ray.
3. The number of atoms of an element emitting one or more types of monochromatic γ-rays may be only a small fraction of the total number disintegrating and a large part of the γ-ray energy emitted may be due to white radiation.
4. A knowledge of the wave-lengths and relative intensities of the lines in the spectrum of the γ-rays is not, in itself, sufficient to enable one to determine effective wave-lengths, which can be used to interpret the results of experiments on γ-rays.

I think it may fairly be said that it is very difficult to explain the results of experiments on γ-rays of very small wave-length. Definite answers to questions 3 and 4 would help very much. There is not space here to give fully my own opinions, which I must reserve for a communication elsewhere.

J. A. GRAY.
Queen's University,
Kingston, Ont., December 6.

Specific and Latent Heats of Iron and Steel.

IN previous letters to NATURE (April 19 and September 20) I gave the results of some experiments on the rate of contraction of heated iron and steel wires, partly commercial steels, and partly of steels formed by heating nearly pure iron in graphite for periods lasting from one to five hours. It was found that even the five hours' heating in graphite did not complete, or even nearly complete, the conversion of iron into steel. A similar and more recent series of trials has now been carried out in which the graphite was replaced by wood-charcoal, from which it appears that the action of the latter is far more rapid than graphite, so much so, indeed, that a wire heated in charcoal for a single minute gives a cooling curve notably different from that of the pure iron.

Some of the results are shown in the accompanying diagram (Fig. 1), where the curves refer to nearly pure iron (4 parts in 10,000 of carbon) and to the same iron after remaining in wood-charcoal at a cherry-red heat for two and a half, five, ten, and twenty minutes, one hour, three hours, and four hours respectively. The greater part of the variation of form occurs in the first half-hour's heating, and the difference between the three-hour and four-hour curves is comparatively small.

In all cases the cooling curves well above and well below the critical temperature (*i.e.* from melting point down to about 800° C. and from 400° C. down to ordinary temperatures) are identical, but the presence of carbon prolongs the time required for the metal to change from the high to the low temperature state.

While this change is proceeding, latent heat is being evolved, and whether the wire rises in temperature and expands (showing what has been called "recalescence") during this process depends on whether the rate of evolution of heat exceeds, or falls short of, the rate at which heat is being lost by radiation and convection.

It has been shown, by experiments previously described in NATURE, that the coefficient of thermal expansion for iron and steel undergoes no discontinuous change at any temperature to which the metal was subjected. Assuming for the present purpose that the coefficient is constant, it will be seen, since the loss of temperature in cooling is proportional to the excess of temperature above the surrounding space, and since also the time taken to cool through a given number of degrees is proportional to the specific heat, that therefore the area contained between the cooling curves and the axis (*i.e.* extension in terms of time) is proportional to the total quantity of heat yielded in the cooling process.

Thus, from the results exhibited in Fig. 1, it appears that

(1) The greater the carbon content of the metal, the longer is the time required to complete the change from the high to the low temperature state, and the lower is the temperature at which the conversion ends.

(2) The greater the carbon content, the less is the total heat necessary to raise the metal from ordinary temperature to anything above 400° C.

(3) The effective specific heat changes continuously while the change of state is in progress, but the change is more and more rapid as the carbon content diminishes, becoming probably instantaneous, or nearly so, for pure iron.

(4) The terminal specific heats (namely, from above 850° and below 400° C.) are very nearly in the ratio of one to three.

All the phenomena presented in the tempering of steel are connected with the change of state, and it seems likely that useful information might be derived from records of the contraction which occurs in cooling if made under standard conditions.

It is worth notice that in all the experiments I have made, a small permanent increase of length has

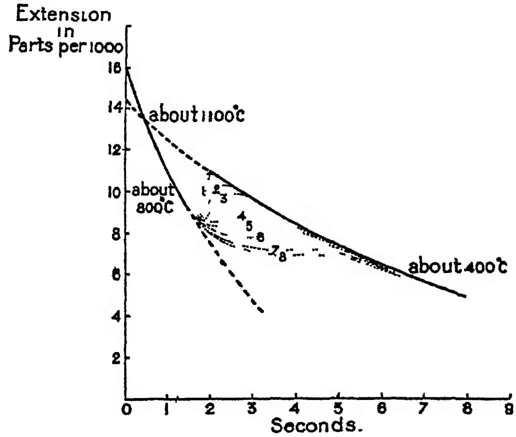

FIG. 1.—Curves showing the contraction of iron and steel wires after heating (by an electric current) in an atmosphere of nitrogen. The iron was produced by the reaction between iron sesquioxide and aluminium. Analysis showed that the metal contained about 4 parts of carbon in 10,000. A small ingot of this iron was drawn into wire of 0·02 in. diameter, and lengths of this wire were heated to a cherry red in wood-charcoal for times specified below. The ordinates of the curves give the extension of the wires at the times indicated by the abscissæ. Approximate temperatures are indicated.

Curve	Time of heating in charcoal
1	0 minutes
2	2½ ,,
3	5 ,,
4	10 ,,
5	20 ,,
6	60 ,,
7	180 ,,
8	240 ,,

occurred at each successive heating when the iron was nearly pure, but that when the carbon content reaches a certain limit this change vanishes, and is replaced by a small permanent contraction when that limit is exceeded. A. MALLOCK.

9 Baring Crescent, Exeter,
December 6.

An Endotrophic Fungus in the Coniferæ.

IN a communication to NATURE of December 13, Prof. F. J. Lewis directs attention to the discovery of intercellular mycelium in the shoot tissues of *Picea canadensis* and other conifers, and also in roots and shoots of *Ledum palustre* and *Vaccinium Vitis-idæa*. Referring to the two last-named species, Prof. Lewis writes: "an examination of the root and stem of *Ledum palustre* and *Vaccinium Vitis-idæa* from this district has been made, and an endotropic [?endotrophic] fungus has been found similar to that described by Rayner (*Annals of Botany*, 1915) in European material."

The fact that endotrophic mycorrhiza occurs in the *roots* of these plants has long been known and calls for no comment. A full account of the mycorrhiza of *V. corymbosum* was given by Coville in 1911 for American material.

In the paper cited by Prof. Lewis, the present writer described the wide distribution of mycelium throughout the shoot tissues of Calluna and recorded the fact of ovarial infection—implying a like distribution of the fungus—in *Ledum palustre* and *Vaccinium*

Vitis-idæa A paper now in the press, recording the regular and extensive digestion of mycelium in the mycorrhiza cells of Calluna, contributes additional details respecting the distribution of mycelium in the shoot of Ling and supplies final experimental proof of the identity of the fungus (in the vegetative shoots as in the fruits) with that found in the (root) mycorrhiza

In view of the conclusions published by Stahl in 1900, the genus Vaccinium is of special interest In a paper shortly to be published, an account will be given of experimental researches on Vaccinium spp extending over a number of years and evidence supplied that the relation between fungus and vascular plant is even more intimate in this genus than in Calluna That roots of Vaccinium are infected by mycelium of the endophyte when growing in sterilised soil was overlooked by Stahl,—as more recently by Christoph in the case of Calluna,—because the formation of typical mycorrhiza is partially inhibited in the roots of both these species when growing in a sterilised medium Under these conditions, the demonstration of mycelium in the mycorrhiza cells demands a more careful technique than was bestowed upon it by either of these observers

The interesting observations on conifers contributed by Prof Lewis confirm the view long held by the present writer, that the distinction between ectotrophic and endotrophic mycorrhizas is one of degree of infection only Many of the so-called ectotrophic forms yield evidence of the presence of intercellular mycelium when a suitable technique is employed This view receives further confirmation from the recent extensive researches of Melin ("Experimentelle Untersuchungen uber die Konstitution und Okologie der Mykorrhizen von *Pinus silvestris* L und *Picea Abies* (L) Karst," *Sonderabd aus myk Untersuch und Berichte*, Bd II, 1923, Stockholm)

At the same time, it must be pointed out that the presence of mycelium throughout the shoot tissues does not in itself constitute a proof of identity with the mycorrhizal fungus of the same plant Experimental proof of such identity has been obtained for Calluna and Vaccinium, but it is perhaps rash to assume, by analogy, that the same is true for *Picea canadensis* and other conifers.

Prof Lewis's allusion to "symbiosis" raises the question of the exact significance to be attached to this term In my opinion the term "symbiosis" can be correctly applied to the relationship between flowering plant and fungus in mycorrhiza plants if it is used as originally defined by de Bary. Its use when *mutualism* is implied is justified only if supported by experimental evidence Each case requires investigation on its merits

M C RAYNER

The Nature of Verse.

THE experimental results reported by Prof Scripture in NATURE of October 11, p 534, are of course to be accepted as accurate, but they do not lead inevitably to his conclusions He is dealing only with "the physical nature of verse," with verse "as it comes from the speaker" and passes to the hearer Of this he gives a faithful and valuable account, but it is wrong to draw conclusions as to the nature of verse from an inquiry into only one aspect of it

To express the rhythmical effect of verse Prof Scripture uses a concept—that of the centroid—which deserves fuller recognition He states that "The simplest English poetical line consists of a quantity of speech-sound distributed so as to produce an effect equivalent to that of a certain number of points of emphasis at definite intervals" Few will take exception to this, so far as it goes, but he draws the conclusion that verse is "purely a matter of rhythm, it has no metre The usual scheme of prosody with feet, syllables, iambus, trochee, etc, is a fantastic fabric of fancy without the faintest foundation in fact"

A certain amount of poetical work makes no claim to be metrical, but apart from this it is untrue, even on Prof Scripture's evidence, that verse "has no metre" If the centroids recur at definite intervals then they may be said to mark out measures, bars, or feet, the "point of emphasis" marking either the beginning or the end of the foot There is no need for the feet to be conterminous with syllables, or to be cut off one from another as if the speech sound were not continuous, or to show any simple or indeed any fixed internal ratio between their parts Prof Scripture may object that this is not the *usual* scheme of prosody, with feet, syllables, etc, that he is attacking But we may believe in metre without supporting the orthodox prosody of mid-Victorian days That scarcely needs slaying thrice, although modern metricians who no longer accept it find the old schemes and terminology convenient to use for rough and ready purposes

A more important point is that Prof. Scripture takes no account of the fact that the physical rhythm is the external manifestation of a psychological rhythm One of his examples illustrates this Whoever read the line from "Hamlet" for him to record evidently felt "is" to be more important than "that," and the record accordingly shows the arrangement of centroids to be

To be or not to be that is the question

But many, if not most, readers would place the point of emphasis on "that"—

To be or not to be that is the question

the record showing a different arrangement of centroids

The nature of the sound rhythm depends on the nature of the mental rhythm with which it corresponds (or perhaps we may find that they are mutually dependent) Consequently, experimental methods, however accurately carried out, can by themselves reach no finality "The first step in the study of verse," says Prof Scripture, "must be the purely physical one of registering and analysing the air-vibrations" But even if this is so, it is not all We have also to inquire why the vibrations come to be arranged in that particular way The problem of metre is not a merely phonetic problem, for the effect of verse depends not merely on some stimulation of the senses, but on something that is a matter for apprehension on a higher or more complex level than mere sensation, on the *recognition* of some sort of recurrence

EGERTON SMITH

Krishnagar College, Bengal
November 17

The Origin of the Satellites of Mercury Lines.

INTEREST in the complex structure of the important lines in the arc spectrum of mercury has been revived by the suggestion of Nagaoka, Sugiura, and Mishima (NATURE, March 29, 1924) that the satellites are due to isotopes of mercury The suggestion is based on the agreement of the wave-lengths calculated according to a hypothetical formula (similar to Kratzer's formula for the spectrum of hydrogen chloride) with

the measured wave-lengths On the other hand, Ruark, Mohler, and Chenault attribute the fine structure of the lines to "transitions between components of complex spectral levels" (NATURE, Oct 18, 1924) They are satisfied that in the great majority of cases it can be proved that fine structures are not due to isotopy

There are two conditions which must be satisfied by lines arising from isotopes. (1) the intensities of the several isotope lines in the radiation from a thin layer must be in the ratio of the concentrations of the respective isotopes, (2) the radiation from the end of a long column should be distinguished by the equalisation of the brightness of corresponding lines when the column is sufficiently long for the lines to be "saturated" We have directed attention to this point in a recent paper (Proc Roy Soc 105, p 527, 1924)

The application of the first test is difficult, but the second is possible in some cases In the case of 5461 Å all the satellites approximately satisfy the second condition, with the exception of one, namely, —·024 Å In the long column radiation the satellite —·024 Å is the brightest line of the group, and all the others are so nearly of equal brightness among themselves that the distinction, based on difference of intensity, between "main line" and "satellite" is lost. It appears to us that if the components of this group are to be attributed to the isotopes of mercury, the line —·024 Å must be excluded from the list. It appears, however, from the note of Nagaoka and his co-workers that they include this line in the isotopic group of 11 satellites, which, together with the main line, make up the whole group of 12 constituting 5461 Å

In the case of the two yellow lines 5791 Å and 5769 Å, these authors state that the observed wave-lengths of the satellites of 5791 Å agree with the calculated wave-lengths, whereas there is no agreement in the case of 5769 Å We, however, find that the side components of 5769 Å can be reversed on a continuous background, and that in long column radiation they approach the main line in brightness, whereas in the case of 5790 Å, we have been able to reverse the main line only, and the ratio of emission to absorption is greater for the satellites than for the main line Thus the components of 5769 Å appear to satisfy the second condition we have mentioned above, while those of 5971 Å do not

E P METCALFE
B. VENKATESACHAR

Central College, Bangalore,
University of Mysore,
November 27.

Chemical Combination of Helium.

THE views of Franck on the existence of a metastable form of helium capable of forming chemical compounds have led me, at the suggestion of Sir Ernest Rutherford, to search for such compounds The experiments carried out during the past year indicate the existence of helium compounds of a different type from the mercury helide described by J J. Manley in NATURE of December 13, p. 861.

I have examined mixtures of helium with the vapours of mercury, iodine, sulphur, and phosphorus under the influence of electron bombardment and in the presence of surfaces cooled by liquid air. I find the helium disappears almost completely at a rate much greater than that observed under the ordinary conditions in a discharge tube Solid substances, which I believe to be compounds of helium, were condensed on the cold surface together with an excess of the other element used

Numerous experiments were carried out which showed that the effect was not due to mechanical occlusion or adsorption In the absence of a cold surface, a slow and very slight disappearance occurred, and the helium could only be recovered by heating the apparatus to 300° C Experiments showed that this absorption or mechanical occlusion of helium in condensed vapours was very slight

The substances obtained have a vapour pressure of the order of 0·005 mm. of mercury at −185° C On allowing them to warm up, they decompose very suddenly at definite temperatures, and the original amount of helium is recovered In the cases of mercury and iodine, this temperature is approximately −70° C and for sulphur and phosphorus −125° C The only disappearance of helium above these temperatures was of the order to be expected from the experiments described in the preceding paragraph In appearance, the compounds of mercury and iodine are not like the pure elements, but at the temperature of decomposition the appearance changes to that of ordinary deposits In the case of phosphorus, when the reaction is allowed to proceed, the deposit is yellow, but, if no reaction occurs, red phosphorus is obtained as might be expected since the vapour passes over a hot filament

Preliminary determinations of the velocity of reaction have been carried out, and further work on this point is in progress, as well as experiments which it is hoped will determine the composition of the products E. H BOOMER

Cavendish Laboratory,
Cambridge,
December 16.

Double Rainbows.

WHEN the source of light is at a practically infinite distance, as in the case of the sun, the position of the bow is determined only by the positions of the source and of the observer's eye When, therefore, a bow is seen double, there must be two effective sources The phenomenon described by Mr Deodhar in NATURE of December 13, p 860, cannot be explained as due to two parallel rain showers Moreover, his laboratory experiment with a source of light near to the observer would be likely to mislead him, for the conditions brought about by the near approach of the source are greatly and strangely modified (see NATURE, Vol 105, May 27, 1920, p 389)

Two bows of the same radius but about two centres, one above the other, have been observed by the writer, the lower cast by the sun and the upper by the image of the sun reflected in a surface of water In the case described by Mr Deodhar the sun was low and rising, and if the upper bow were due to a reflected image the two bows would gradually separate and not approach one another as he observed them to do

Mr Deodhar does not state in his letter whether he looked round to observe the sun at the moment. Perhaps he would have seen a second source of light, such as a small patch of brilliantly illuminated cloud near to and approaching the sun Another explanation that may be suggested is the duplicating of the sun's image by mirage or some other form of abnormal atmospheric refraction The low altitude of the sun would favour this latter explanation

C O. BARTRUM.

32 Willoughby Road, Hampstead,
December 15.

Historical Aspects of Malaria.[1]

By Dr ANDREW BALFOUR, C.B., C.M.G.

MALARIA AS A DESTROYER

DESPITE all the knowledge gained by able and devoted men, despite the application of that knowledge in certain places, despite heavy expenditure, malaria remains one of the great killing and crippling diseases of the world. Let us consider some of the ancient records and see what they have to tell us. First of all, however, it seems fitting, in the centenary year of Byron's death, to recall the last lines from his "Destruction of Sennacherib"—

> And the might of the Gentile, unsmote by the sword,
> Hath melted like snow in the glance of the Lord.

It is of interest to note that Genovese, an Italian author who recently wrote an informative paper on "La malaria castrense"—that is to say, malaria in camps and incidentally in armies—is inclined to attribute the destruction of the Assyrian host to malaria. It is of course impossible to be certain, but Palestine, then as now, was an intensely malarious country, and it is conceivable that a severe outbreak of malaria decimated the Assyrian army. If so the poet unwittingly approached the truth when he wrote

> For the Angel of Death spread his wings on the blast—

though, as only the female mosquito attacks man, *her* wings would have been nearer the mark. The rapidity with which the destruction was accomplished as recorded in the Book of Kings is against malaria, but we need not take too *literally* the single night in which it is said that a hundred fourscore and five thousand perished.

Although it is impossible to speak with certainty, there is little doubt that ancient Egypt was heavily plagued by malaria. We know that it was a country full of great marshes, the remains of some of which persist to the present day, and the following passage from Deuteronomy has been cited as evidence of the existence of paludism: "The Lord shall smite thee with a consumption and with a fever and with an inflammation and *with an extreme burning* and with the sword and with blasting and with mildew; and they shall pursue thee until thou perish."

It is not, however, until we turn to ancient Greece that we obtain anything like a true picture of malaria and its ravages. In "Malaria and Greek History," which Mr W. H. S. Jones, of Cambridge, inspired by Sir Ronald Ross, wrote and published in 1909, it is claimed that malaria was the cause of Grecian decadence. Mr Jones speaks of the malaria blight which fell upon many fertile districts of Greece about the fifth century B.C. He quotes the Wasps of Aristophanes to show that malaria, the "nightmare" disease as it was called, had invaded Attica, and that fevers and agues throttled the sires and grandsires of the Athenian people. He cites the treatise of Hippocrates on Airs, Waters and Places as proof that the father of medicine was very familiar with the dire results of malaria cachexia, with that chronic malaria which even to-day is wellnigh as hard to cure as it is to endure. Those who drink the water of marshes, said Hippocrates, have large spleens, but thin faces and shoulders. Again, after referring to the lowering of the birth-rate, owing to the physical condition of the women and the shortening of the span of life, he describes in a famous passage the people who dwell in low meadowy and hot districts, where the winds and waters are warm, as neither tall nor well-built, but short, fleshy, dark-haired, dark-coloured and bilious. They are neither courageous, nor of great powers of endurance. The stoutness to which reference is made is doubtless perplexing, for the malarial cachectic is usually emaciated, but it may imply that the sufferers were œdematous or in an unwholesome condition. There can be no doubt that in 400 B.C. large tracts of Greece were in a miserable state owing to malaria, while 200 years later the assertions of Polybius as regards the rapid depopulation of the country owing partly to emigration, partly to a heavy mortality, point, in some measure, to its malign influence.

In the olden days marshes surrounded Athens. The Stadium was a swamp, and armies fighting round the capital suffered enormous losses. It is recorded by Polyænus that Clearchus the tyrant, with the view of getting rid of a number of riotous and disaffected citizens, conscripted them to invest a town "in the dog days"—that is to say, in the summer—and made them encamp in a marshy plain "ill-ventilated and full of marshy pools," while he and his mercenaries occupied the surrounding hills. The effect was rapid and terrible, for the wretched men were wiped out by malaria. It is true that Dr Cardamatis, of Athens, a well-known malariologist, does not agree with the conclusion reached by Mr Jones, for he thinks the English author has overlooked the remarkable reclamation works carried out by the ancient Greeks, notably by the Minyans on Lake Kopais. He attributes the decay of the nation to other causes than malaria, but, be that as it may, the destructive agency of the mosquito-borne disease is well exemplified in ancient Greece, where towns were actually given names signifying "heavy sickness." Some of these names, such as Kounoupia, Konopina, and Kounopitsa, exist to-day.

There are some who would attribute the decline and fall of Rome to the evil influence of malaria, and certainly in olden days the environs of the imperial city were described by classic authors, such as Cicero and Livy, as "Pestilentia." Tacitus states that Gallic and Germanic troops suffered severely by camping in the insalubrious neighbourhood of the Vatican, where the lands were covered with stagnant water and the air was unwholesome. Even at the present day a suburb of Rome is called "The Vale of Hell," and three-quarters of its inhabitants are saturated with malaria.

Genovese, already quoted, refers again and again to the havoc wrought by malaria amongst armed hosts. Many large Carthaginian armies faded "like mists before the wind" because of it, and the losses amongst the Roman armies in the wars against Hannibal must have been incalculable.

It is Banister the American, however, who brings things nearer home, for he declares that Brennus would undoubtedly have taken the Capitol at Rome had he

[1] From a discourse delivered at the Royal Institution on Friday, May 23.

not, in A.D. 208, lost in "Caledonia stern and wild" 50,000 out of 80,000 men from malaria.

So much for Europe long ago. A single example may be culled from the tropics, from the fate which overtook the people who built the lost cities of Ceylon, those wonderful ruins in its north central areas. Lucius Nicholl, of Colombo, believes, with some reason, that their ruin was occasioned by malaria. He points out that the ancient cities really owed their existence to the field labourers, who, by constructing tanks and by rice cultivation, made the country prosperous and self-supporting. It is reasonable to assume that the stress of devitalising diseases would fall upon them, and as the climate and the rainfall have not altered, there is every probability that malaria was imported from India with dire results.

However interesting and suggestive these records and experiences from ancient times may be, they scarcely appeal so forcibly as those from later periods. Take the extermination in the Roman Campagna in 1167 of the finest army ever commanded by Frederick Barbarossa. So rapid and awful was the destruction that the writers of the time have represented the disease as a "black cloud which covered all the valley near the Monte Mario, where the army was situated, and poisoned the air." A heavy rain had fallen in August and converted the place into a boundless swamp; then followed an enervating spell of hot weather, and an irresistible invasion of the wretched troops by fever. "Obscure soldiers, nobles and illustrious prelates laid down their lives there," says Genovese. The flower of a nation was exterminated, while in the same outbreak Rome lost some 20,000 inhabitants. Throughout the Middle Ages there were many deadly epidemics of the disease, like that of 1557–58 in England.

Let us fare to the tropics once again, and see how malaria wrecked high hopes and a well-found expedition when the ill-fated Scottish Darien scheme came to nought. The settlers landed on a pestiferous spot of land in 1698 and speedily came to grief, mainly, if not wholly, by reason of disease. There can be little doubt that malaria was the chief malady which overcame them, though yellow fever may possibly have been operative. At any rate, the "Memoirs" of the Rev. Francis Borland, who was one of the chaplains to the second portion of the expedition, leave one in no doubt that mosquito-borne fevers wrecked the enterprise. Two hundred years later a similar want of skill, due chiefly to lack of knowledge, occasioned, not far from Darien, a similar melancholy tragedy when the French failed in their great endeavour at Panama. It must be remembered that, though yellow fever proved their main adversary, malaria wrought much havoc in their ranks. It was left to the Americans, the heirs to learning gained partly by others, partly by themselves, to triumph over malign local conditions.

I have spoken of camps and armies, but navies have also felt the weight of malaria; the British Navy has suffered from it time and again. Perhaps the most dolorous account of its ravages is to be found in the records of the forgotten Batavian endemic, as it was called, which occurred in June 1800, when we were fighting the Dutch in Java. The ships concerned were the *Centurion* and the *Daedalus*—historic names. Seamen, marines, and soldiers alike suffered. The place of tragedy was the small island of Edam, nine miles off-shore from the low swampy grounds of Batavia, and the remarks of Shields, the naval surgeon who is the chronicler of the disaster, are highly suggestive. He speaks first of Onrust, a small island only three miles from the main, well cleared of trees, underwood and jungle, nearly flat and free from swamps and marshes. Speaking of the sick brought here from the ships blockading Batavia, he says:

"From the fœtid exhalations, which were conveyed by the land winds from the neighbourhood of Batavia, the sick were easily secured, by closing certain apertures in their apartments, till the sun dispersed the vapours in the morning; after which there did not appear to be any danger from the miasmata disengaged during the day. Edam, on the other hand, though farther out of the reach of Batavian exhalations, is covered with trees, long grass and jungle, having a part of the island itself in a stagnant, marshy state. The buildings here were indifferent, and only one long ward could be found for the sick and convalescents; in consequence of which the latter class of patients experienced all those dire effects produced by the depressing passions, forever nurtured by the melancholy scenes of death, which this fatal spot too constantly presented to their view! Thus, in running from a doubtful danger, they precipitated themselves on certain destruction. In leaving Onrust (a cleared space) to avoid the effluvium of Batavia, weakened and diluted by a three miles passage from its source, they settled on the jungly and marshy island of Edam, where pestilent miasmata, in a concentrated form, issued from every foot of ground around them! The fatal effects which followed were predicted by an intelligent surgeon on the spot, but his suggestions were disregarded or overruled; *distance* from the main being held paramount to all other considerations."

I might trace the deadliness of malaria from the Walcheren expedition, which it ruined, to the Crimea, where it played havoc, and on to Macedonia where it, more than any other single factor, rendered the Allied Forces in the War comparatively impotent. I might tell you of great epidemics in India, of its strangling hold on the West Coast of Africa, of how the Indians in Mexico suffer and die from it; of the appalling conditions at present existing in Southern Russia; but I prefer to take one great classical example of its powers for evil within recent times—its invasion of Mauritius. It is unnecessary to consider the rights or wrongs of the story generally believed—to wit, that in the late 'sixties of last century, African malaria-carrying mosquitoes were introduced from a sailing ship, multiplied exceedingly, found infected blood already present in the bodies of Indians from India or Creoles from Africa, and commenced spreading the parasite, and incidentally the disease. I would rather give one or two passages from a book on Mauritius by Nicholas Pike, who was American Consul at Port Louis in 1867–1868, and was an eye-witness of the scenes.

"Those who inhabited Port Louis," he says, "during the terrible mortality in 1867 and 1868 will never forget the sad spectacles the city presented daily. Fever! Fever! was the only word on every lip—the only thought in every heart. Mourning and desolation everywhere. Scarcely a person visible that did not wear the garb of woe. Song and laughter had ceased.

"Port Louis was once remarkable for the number

of pianos heard in every street in an evening, from the Erard's grand and semi-grand to the humblest cottage instrument

"At this time it was literally 'The daughters of music were brought low and the voice of mourning was heard in the streets' Funeral trains were met at every corner Relays of men were kept busy night and day digging the graves"

I have seen these graves, mute witnesses to the severity of the outbreak, to the dire results of ignorance For months an average of 200 people died per day in Port Louis, and scenes such as Pike describes were common

Think of what all this means, and what the discovery of the malaria parasite, and of the method of infection by the mosquito, has meant, and how much more it would mean if only men and governments would act energetically and enthusiastically upon the knowledge gained When Mauritius passed through its furnace of affliction, and 31,920 persons perished, Laveran was a student at Strasbourg and Ross a schoolboy at Ryde

We have dealt with malaria as a destroyer *en masse*, but before looking at the reverse side of the medal and noting how it has benefited mankind, let us see what it has done in the way of removing notable persons in the historical sense, some of whom at least were valuable assets either to the communities they served or to the world at large Naturally enough it is difficult to obtain trustworthy records from the far past In those days the word fever covered, if not a multitude of sins, a great variety of febrile disorders, and it is only in a few cases that definite clinical evidence is forthcoming which enables us to say that so-and-so undoubtedly perished from malaria Even in comparatively recent times accurate diagnosis was difficult, for malaria is a very protean disease, and cannot be definitely predicated without the use of the microscope Hence my examples are scanty and some are doubtful

Alexander the Great conquered the world, but there is some reason to believe that malaria conquered him, aided by his excesses and his disregard of precautions Vasco da Gama voyaged half round the globe, but he voyaged to another, and it is to be hoped a better, land at the bidding of the malarial plasmodium—at least so it has been said Anyhow he died of fever at Cochin, and his fatal illness was probably malarial in origin "The wisest fool in Christendom" was undoubtedly killed by malaria He died of ague at Theobalds One of his predecessor's stoutest, but not too reputable servants, the bold Sir John Hawkins, had his end hastened by, if indeed it was not actually due to, the same disorder Oliver Cromwell also, who died of ague at Whitehall, yielded his life to the insidious attack of the malarial parasite Whether Byron was a victim of the disease when he died in his beloved Greece is a moot point Sir Ronald Ross is inclined to think malaria was not guilty in this instance

Careful research might add other names to this brief list One would expect that of the great explorers in the tropics some were wiped out by malaria, but I have not been able to find indubitable evidence in the case of the greatest of them.

MALARIA AS A BENEFACTOR

Until very recently it would not have been possible to adduce evidence showing any *direct* benefit to man from the disease malaria, but a surprising development took place a few years ago when Prof Wagner-Jauregg, of Vienna, began to treat cases of general paralysis of the insane—the dreaded G P I —by introducing into the blood of patients the organism causing malaria, thereby producing in these patients attacks of malarial fever He had noticed, as had others, the beneficial effects of febrile attacks in cases of general paralysis, and conceived the idea of inducing high temperature repeated at short intervals It occurred to him that this is what the malaria parasite accomplishes in its victims, and that it might be used as a curative agent Although patients were treated on these lines so early as 1917, nothing was published on the subject until 1920, but the remarkable results obtained in certain instances, and the fact that, in most cases, distinct benefit resulted, led to extensive trials of the new treatment on the Continent, and later to its employment in Great Britain

Ere now one malady has been used to combat another, but never before has a serious disease been utilised in therapeutics which, once its good work is accomplished, can be effectively and speedily controlled. This is possible in the case of malaria, thanks to quinine, which, so far as its introduction into Europe is concerned, we owe to a woman, the Countess of Chinchon We are able also to select one of the three forms of malaria which is the least dangerous, but naturally care must be taken that this use of the malaria parasite as a drug does not result in its dissemination by mosquitoes from those treated by it In Great Britain there is little danger of such an accident, but in Germany serious attention has been directed to it

The method, promising though it be, is still in its infancy It is possible that it may be applicable to other diseases of the central nervous system, at least those due like G P I to a specific spirochæte, but great care must be exercised, and this new therapy should be in the hands of experts familiar with the malarial plasmodium, and able also to gauge its effects. Those effects, it may be said, are not exercised on the other parasite, the spirochæte, nor does the high temperature affect this invader The action appears to be on the damaged tissues of the brain itself, but the precise mechanism is still obscure If, however, malaria proves itself able to cope with locomotor ataxia, with disseminated sclerosis, and with paralysis agitans, then indeed it will be hailed as a benefactor, and be considered as having in some small degree made amends for its past atrocities

Indirectly malaria has undoubtedly aided the human race Mr Jones ingeniously argues that it was responsible for the increased respect shown for women in the later days of ancient Greece, and cites the New Comedy (320–250 B C) as proof thereof He considers that the value of women as nurses was made apparent by it, and that, as the wife was usually the nurse, endemic malaria vastly increased her duties and importance

The chief indirect beneficial action of malaria is to be found, however, in the way it has stimulated men to thought and action From the earliest days mankind was forced to exercise ingenuity in protecting themselves from fever. Egyptian and Cretan fishermen slept under fishing-nets folded again and again until their meshes were small They believed they were

excluding miasmata, but they were really keeping mosquitoes at bay Yet so little is history regarded, perhaps because Herodotus wrote of this habit of Egyptian fishermen as a mere curiosity, that we find Prof Traill in 1837 stating that the proposal to defend the body against marsh miasma by the interposition of gauze nets was first made by Rigaud de l'Isle in 1817, and recording that Brocchi had taken up the same idea, and averred that he had successfully employed it against malaria

Malaria inclined men from very early days to attribute the infection of fevers to mosquitoes or other biting insects. Susruta, an Indian physician who probably flourished in the fifth century B C, taught this truth, and there is a picture of him expounding it to an Eastern potentate

Varro and Columella at the time of the Christian era associated mosquitoes with insects bred in marshes, but perhaps the most remarkable announcement was that of Lancisi, who, in 1717, stated that marshes were the cause of the fever owing to the transformation of minute worms into "stridulous culices," and that the poisoned animals kill, not by the wounds which they inflict, but by infusing a poisoned liquid through the wounds The Abbé de Fortis, writing of his "Voyage in Dalmatia" in 1774, refers to his meeting with an ecclesiastic who suspected that fevers were due to insects, the infection being derived from corpses or poisonous plants, and who thought that miasmas might be conveyed in this manner. The conjecture, says the Abbé, is at least ingenious

So it went on with such protagonists as Nott the American, Beauperthuy the famous French Creole, Finlay of Havana, and King, the soundest of them all, reasoning and arguing in favour of the hypothesis and none paying much attention to them. Yet malaria had taught benighted barbarians the lesson and they had accepted it. Richard Burton in his "First Footsteps in East Africa," published in 1856, states that the people of Zayla in Somaliland believed that mosquito bites occasion deadly fevers, and says that the superstition (save the mark !) probably arose from the fact that mosquitoes and fevers became formidable about the same time

But malaria led also to closer and more scientific reasoning. The ancestors of the malaria parasite were probably coccidia, tiny protozoa inhabiting the cells lining the wall of the intestine Some of these, naturally enough perhaps, got a little discontented with their surroundings, changed their habit of life, and eventually found a more congenial habitat in the red blood corpuscles Now Richard Pfeiffer, a trained observer, had been studying the coccidia of rabbits in 1889–90 He noticed that these parasites not only multiplied within their host, the rabbit, but, in a special resistant form, provided for their transference to another rabbit once they had got outside the body of their original host He recognised that the multiplication of the coccidia in the epithelial cells of rabbits and that of the malaria parasite in the red blood cells of man was a very similar destructive process, and thought that possibly the malaria parasite, like the coccidium, might have two cycles of development. If so it would have to get outside man's body Provided it did not produce any resistant form to enable it to withstand the dangers it would encounter in the wide, wide world, say in soil or water (and such a form was unknown), he considered that it might make use of some insect in which, sheltered and comfortable, it could undergo the second, or as it is called exogenous, cycle of its development It could then, as Koch had suggested to him, get back to man through the bite of some blood-sucking insect

This, as events have shown, was a prophetic utterance, but it was linked up with the earlier work of the great Sir Patrick Manson, who, long before, working in Amoy, far from books and skilled help, had proved that a mosquito served as the intermediate host of a human blood parasite, that tiny filarial worm, to the presence of which in the human body the disease elephantiasis is attributable He showed that the mosquito was a necessary link for the fulfilment of the life-cycle of the bloodworm This was a new conception in pathology of which both Koch and Pfeiffer were aware Still this does not detract from the merit of Pfeiffer's carefully reasoned hypothesis Neither he nor Koch, however, followed up the matter The solution of the problem was left to Ross, who, at Manson's instigation, took up the work in India, and after manifold trials and tribulations emerged victorious Certain Italian observers also contributed notably to our knowledge, and Ross himself, not content with mere scientific work, at once turned it to practical account

Malaria, then, benefited man by stimulating him to undertake work for its own destruction, surely rather an altruistic action, and not unlike that of the medical profession itself. This stimulation has had other and far-reaching results, for, more or less as a direct outcome of the discoveries regarding malaria transmission and prevention, attention was directed to all kinds of protozoal and allied diseases The American work on yellow fever was, in fact, the sequel to the researches of Ross, and an immense stimulus was given to the scientific study of tropical medicine and hygiene One of the latest developments has been the application of electricity for the purpose of destroying mosquito larvæ and pupæ Montellano, of Argentina, introduced the method of electrocution which is now being given an extensive trial

Not only did malaria excite inquiry and interest, but education of the public was also found needful, and propaganda were launched broadcast Man's ingenuity was stimulated afresh, for it was by no means easy to explain to lay audiences the intricate life-history of the malaria parasite; and further, his enthusiasm was aroused in an endeavour to present the problems of preventive work in an attractive and effective manner. Here it is that the Americans have forged ahead Malaria is a very serious problem throughout the Southern United States, and indeed has been the reason why some of them have, until lately, been backward and depressed. The Americans are a practical people, and moreover are easily fired by that idealism which, if well regulated, so often spells success Hence they have spared neither time nor money in combating malaria and bringing before the public by cinematographic films and other educational means the mysteries of the life-cycle of one of man's greatest foes, the measures taken to defeat it, and the results of a campaign well and truly waged.

Fuel Oil Resources of the Future.

By H. B. Milner

PUBLIC attention has once again been directed to the vital question of the world's resources of petroleum, in a paper read before the Institution of Petroleum Technologists by Prof A W. Nash and Mr H G Shatwell on December 2, and further by a column having reference to that communication in the *Times* of December 3 The object of the paper is to allay uneasiness existing in the minds of many with regard to the adequacy of future oil resources

The argument requires that before justifiable fears are entertained we must be satisfied that all free petroleum in the earth has been located, that the problem of the origin of petroleum has been solved, and that "oilfields can be discovered and not simply located as a result of surface workings by local inhabitants" Alternative to natural mineral oil are "the abundant stores of bituminous material from which oil can be obtained by destructive distillation," these being oil shales, cannel coals, torbanites, lignites, peat, and coal

With regard to the first point, it is maintained that outside America the search for oil has not been carried on diligently, and the implication is that, following precedent in the history of the American oil industry, more fields should be developed in other countries Then, the problem of the origin of petroleum not having been solved to general satisfaction, it is argued that it is impossible to state definitely that oil is not in process of formation at the present time. The third point is obscure both in definition and in amplification, though it is implied that improved technique is necessary in the initial stages of oil exploration. The arguments in favour of the development of alternative fuel resources are not new, though great stress is laid on the commercial possibilities of "berginisation" of coal and oil as a promising method of obtaining a substitute for natural petroleum

It is difficult, despite the good case made out by the authors for peace of mind in connexion with future oil supply, to share fully their optimism, because while some agreement may be accorded with the facts they adduce in support of their opinions, their interpretation of the position and the conclusions they reach, since they are based on no new data, are open to question as much from economic as from technical points of view.

Misapprehension concerning the future of oil-fuel supplies was first of all felt and voiced, not by an irresponsible section of the community, but by experts both in the United States and in Europe, who realised the true drift of events Far-sighted people, from an examination of the position from every angle—national, technical, economic—gradually came to see that if production did not keep pace with an ever-growing consumption, a most serious position would arise, probably within the course of two decades or so Uneasiness spread, therefore, despite insistent press contradictions, instigated by interested persons, who did not hesitate to write up glowing accounts of a contemporary "oil age," and to quote misleading statistics to prove their optimistic contentions Thus the industry and the public were entitled to an unbiassed knowledge of the facts, and also to considered and authoritative judgment on the position, either as a clear warning to be prepared for the worst, or as a vindication of the light-hearted optimism expressed in some quarters. The authors have therefore done well in bringing the matter once more to the front, even though we cannot agree with the reasons they consider sufficient to disarm fear for the future.

First, it is, we agree, reasonable to believe that all available petroleum has not yet been located; it would indeed be a poor outlook if this were so. But it is a question of magnitude of resources to be tapped, not merely the discovery of several comparatively small oil-pools We have to ask ourselves whether, from broad geological knowledge of the world, there exist accessible regions outside the United States, where geological conditions are likely to favour the preservation of oil deposits on the vast scale which has made the industry in that country, and latterly in the world, what it is? Can we point to a second Pennsylvanian, Mid-Continent, or Californian region anywhere with any degree of scientific possibility? It is difficult to do so. It is, of course, possible to predict many localities likely to yield a future oil supply, on a par with, say, Persia, or Sarawak, at the present time, but it is not easy to visualise the existence of oil-pools the collective exploitation of which will determine an ultimate supply on the scale at present requisite, or likely to be demanded in the near future, if and when the United States with Mexico cease to yield 80 per cent of the world's total output

Secondly, we may agree with the authors that the mode of origin of petroleum still remains debatable, despite more than thirty years of philosophy, but even if the problem were solved to universal satisfaction to-morrow, would the knowledge lead us to the location of deposits at present forming, and would such deposits be likely to have immediate economic value even if they were found? Whatever theory be advanced to account for the origin and accumulation of petroleum, the geological time-factor seems to be an inevitable influence in the mechanism, and yet we are asked to contemplate the prospect of contemporary petroleum, ripe for use, if not just at the moment, at least within the next few decades! An accepted solution of the genesis of petroleum is desirable for many reasons—mainly scientific—but the immediate economic significance of such a solution if arrived at, as indicative of a new line of field-investigation, is difficult to follow

Thirdly, the authors suggest that mere geological examination of potential oil-bearing territory is insufficient, and should be accompanied at the outset by a drilling staff "to drill for geological information and not for oil" Where is the philanthropic company which can be persuaded to finance such a proposition? Further, the platitude is expressed that the science of geology of petroleum is an inexact one, since geology itself cannot be classed as an exact science, obviously a particular application must, *a priori*, be inexact But is it a whit more precise, as is implied, to encourage wholesale "wild-catting" of a kind which, while admittedly advisable from the purely technical aspect of field-geology, might only result in more failures to find oil, certainly in a heavier initial expenditure which the

average company director would never agree to incur, not even in these enlightened days of intelligent directorates? If the geologist is to be of any use at all in locating oil deposits, his work must precede exploratory drilling, for economic, if for no other reasons.

The authors also review the existing position of oil supply and mention more particularly possibilities in Persia. In this connexion, while sharing their opinion, we may be allowed the remark that even if Persia doubles her production in the next year or two, it would only represent 5 per cent. of the world's output at the present rate. They also stress the potentialities of the Canadian Athabasca tar-sands, a proper utilisation of only 25 per cent. of which would, they say, remove apprehension regarding the future. We refer them to the recent report by S. C. Ells (Bituminous Sands of Northern Alberta, 1924), in which he states (in reference to tar-springs) that "in no instances are they themselves of commercial value as a source of bitumen. They have, at times, been regarded erroneously as a definite indication of the presence of petroleum pools." Later, summarising several processes devised for producing oil from these tar-sands, he says, "The results of this work are as yet inconclusive."

A further "off-set" to shortage of supply is the possibility of mining for recoverable oil from abandoned oil-fields by shafts and galleries, as at Pechelbronn; this principle, apart from the human factors involved, may be economic with shallow sands in some cases, but what of oil-sands lying between 3000 and 5000 feet below the surface: would the method be practicable, and does it therefore help the solution of the difficulty?

Lastly, we reach the question of alternative fuel resources, and here, while the authors are to be congratulated on the way they have marshalled the possibilities of shales and coals, they should in fairness have laid more stress on the technical difficulties at present in the way of utilising these resources on a satisfactory commercial scale. The world's known resources of oil-shale are now generally appreciated, but the estimates given by Alderson and others as to the amount of oil recoverable from them are quite fictitious until suitable retorts and processes are devised for treating them economically, while apart from any other difficulty, desulphurisation of shale-oil and high refining losses still remain in many cases thorny impediments to development, as in Great Britain.

The difficulties concerned with coal and allied carbonaceous material as a source of oil are similarly those concerned with large-scale treatment for commercial supply. Low temperature carbonisation is, from the economic point of view, a process which has yet to be extended under modern conditions of fuel supply and efficiency. Even if successful, oil thus obtained, as the authors admit, can never adequately replace petroleum products. The "berginisation" of coal and oil, regarded by the authors as being of great promise, is in an experimental stage, and much ground has yet to be covered before the application is a practicable one from a commercial point of view. This process consists in heating in the presence of hydrogen a mixture of powdered coal containing less than 85 per cent. of carbon, with mineral oil or tar oil at high pressure (100 atm.) and temperature (400°-430° C.), when a liquid product closely resembling petroleum results. It may be pointed out that unless the liquid product is capable on refinement of yielding a range of products which will take the place of petrol, kerosene, lubricating oil and fuel oil, the process loses at once in value as a means of producing artificial fuels. At present we have little trustworthy data concerning either the refinement or the quality of such "berginised" oil.

Thus the whole question remains in an unsatisfactory position, and it cannot be said that a critical examination of the authors' thesis advances things much further. We endorse, as every student of science will do, their insistence on the need for research, not only for posterity, but also for our own sakes. Conservation of petroleum resources will automatically come, whether we urge it or not, since for strategic reasons alone the United States will ultimately have to limit its exports of oil, and that, too, within the next two decades, if further large supplies are not forthcoming. Once the United States decides on that policy, Europe and all other countries dependent on it for the larger proportion of their oil-fuel requirements will have to face the inevitable, and either economise in the use of petrol and petroleum products, or provide some alternative, but probably in the long run, far less convenient fuels and lubricants.

Hence the keynote to the situation may be summed up in the word economy. The present heavy-handed use of petroleum results from a general impression that there is plenty more where the present supply comes from, an extravagant idea inculcated by the same policy responsible for recent deplorable over-production and wasteful consumption. If the industry, by adopting in the future the practice of husbanding existing resources and by straining every scientific nerve to a higher technique in production, refinement and utilisation of oil-fuel, thus sets the example to the public, the public itself will be educated. Decline in cumulative production in such circumstances will be slow; the full and beneficial effect of each new discovery of an oil-pool, however small, will also have time to operate, and the gaining of time in one way means that the chances of developing new schemes of alternative fuels, as outlined by the authors, are more likely to meet with success, at all events as commercial propositions.

Some people hold that we should enjoy the gift bestowed on our own generation, the privilege of living in an "oil age," and leave posterity to take care of itself. This is neither a credit to contemporary knowledge, nor is it in keeping with the best traditions of scientific progress. We owe it to ourselves to face the situation as repeatedly exposed by David White, Pogue, and others qualified to judge, and whatever position may ultimately be created by a shortage of natural petroleum, we have to see that we are not unprepared to meet the contingency either through lack of foresight or of initiative in perfecting substitutes. But we have also to realise that the prospect of supplanting petroleum by alternative, artificial fuels is confined largely to the realm of experimental possibilities; merely to define the possibilities is not necessarily to remove the qualms which still exist in the minds of not a small section of workers in the oil industry.

Current Topics and Events.

IT is a biological commonplace that every species of animal (man included) tends to increase in numbers if left free to propagate without restraint This restraint is, however, always forthcoming when the population reaches a certain degree of saturation, and in the case of the human race it has in the past taken three forms, namely, war, famine, and pestilence During the fourteenth century there were seven famines in England, in which the people died like flies, and towards the close of the century the Black Death wiped out three-quarters of the population. We are familiar with the ravages of the Great Plague in London in 1666, during which 100,000 people died, but few realise that in the preceding century there were two similar visitations, and in the earlier one, which occurred in Elizabeth's reign, 65,000 people died The Queen and Court fled to Windsor, and the Queen had a gallows erected in the market-place, and gave orders that every Londoner who appeared in the town should be hanged !

WITH the development of our social sense, which is the real measure of our advance in civilisation, the suffering and sorrow involved in these calamities have become abhorrent to us, and a certain proportion of our population, chiefly the better educated members of it, have learned so to limit their families that they are able to give to each child its proper share of care, food, and affection But the greater part of the population, including most of the manual workers, are without this knowledge, and amongst them the lowest, poorest paid, and least skilled are the most prolific The Walworth Women's Welfare Centre (153A East Street, Walworth, S E), the annual report of which has recently been received, was established with the object of teaching the poorer women harmless means of preventing conception, so that the births may be properly spaced and the children given a chance of healthy development A distinguished Dutch medical man, Dr Jansen, in a book entitled "Feebleness of Growth," has given reason to believe that in successive children produced by rapidly succeeding pregnancies, there is a progressive physical degeneration manifesting itself in stunted growth and deformities of various kinds It would seem that birth-control should ultimately replace natural selection as a limiting factor in human affairs: but if it is confined as at present to the best elements of the population, it must cause the deterioration of the quality of the race The aim of the Walworth centre and of the newly established centre in North Kensington is to spread the knowledge amongst those who need it most

THOUGH to-day some 2,000,000 tons of shipping are propelled by internal combustion engines of the Diesel type, a new chapter in the history of the motor ship may be said to have been opened with the recent trials of the M S *Oorangi* built by the Fairfield Shipbuilding and Engineering Company of Govan for the Union Steamship Company of New Zealand The *Oorangi* (the name is the Maori for Mount Cook) is the first large and fast passenger vessel to be fitted with Diesel engines The ship is 23,000 tons displacement, 600 feet long by 72 feet beam, and will carry about 1300 passengers and crew and a considerable amount of cargo It is designed for the long run from Vancouver to New Zealand and Australia, on which it is expected that an average speed of 17½ knots will be maintained The main interest lies in the vessel's machinery There are many types of Diesel engines being produced to-day, but the engines of the *Oorangi* are of the Sulzer type, two-stroke, single-acting, as developed by the famous Swiss firm of Sulzer Brothers of Winterthur There are four sets of main engines driving four shafts, each set having six cylinders 27½ inches diameter, 39 inches stroke, the whole 24 cylinders developing some 15,000 B H P, equivalent to 19,750 I H P The air compressors for supplying the air, at 1000 lb. pressure, for injecting the fuel are worked off the main engines, while the low-pressure air supply for scavenging is obtained from three turbo-blowers driven by electro motors There are also two electro motor-driven high-pressure air compressors for supplying the starting air when manœuvring in and out of port, while the electric power installation for the ship consists of four 350 kw generators driven by Sulzer-Diesel engines of 420 B H P Some of the auxiliaries in the ship, such as the refrigerators and winches, are driven by steam supplied from two ordinary marine boilers burning oil The ship carries about 3000 tons of oil fuel, which is sufficient for the round voyage between Vancouver and Sydney As pointed out by Engineer-Admiral Sir George Goodwin in his Hawksley Lecture to the Institution of Mechanical Engineers on November 7, there are many considerations to be taken into account when deciding upon the type of machinery for any particular ship, and the performances of the *Oorangi* at sea will be followed with great interest

THE value of an international language for promoting amity among nations, and its obvious advantages for use in international trade, have been much emphasised by those who are convinced of the practicability of such a project, but its presumptive value to men of science has, perhaps, not yet received due attention The work of a large number of scientific and technical societies is severely handicapped by the greatly increased costs of printing and publication, and the adoption of a single language for communicating abstracts from scientific literature, as well as for papers and treatises of exceptional importance, would undoubtedly effect economies in money and effort. In a recent issue of the Proceedings of the American Philosophical Society (vol lxiii, No 1), Prof R. G Kent, of the University of Pennsylvania, makes a thoughtful contribution to this subject After referring to the use of Latin by scientific investigators from about A D 1500 until 1775, and to the recrudescence of national feeling and national languages since the War, the author declares that the language burden has now become too great

even for the professional philologist and *littérateur* He discusses the merits of the chief languages that have been suggested for international use, and comes to the conclusion that Latin is best for scientific purposes Latin has a vocabulary that is essentially international, and a technical terminology which is already very wide and capable of easy and indefinite extension Although ease of acquirement and brevity are valuable characteristics of an international language, a recognised and unquestioned standard of meaning is even more important Latin has an objective standard of word-meaning, and by reason of its terminations, word-order, and moderate use of auxiliaries, it allows of complete precision in indicating the relations of words to one another, it is reasonably phonetic, it is still used for constructing new words required in science, of all non-native languages, it is most studied in European and American schools, and its use would not inflame international jealousy Prof Kent advocates the use of a simple Latin, *i e* one with short sentences and few clauses, together with a slightly increased number of prepositions Thus modified, he thinks that Latin would stand supreme as a means of conveying scientific thought to an international public.

AT the last meeting of the Newcomen Society held on December 17, another valuable contribution was made to the early history of mechanical engineering by Mr Forward in a paper on "The Early History of the Cylinder Boring Machine" The lathe, the planing machine, and the boring machine have all been developed into very powerful and accurate machines, but some of their principal features can be traced back to the pioneering machines It was the steam engines of Newcomen, Smeaton and Watt which created the demand for cylinder-boring machines, and one of the first is that described by Smeaton as seen at the Carron Ironworks, but it was as imperfect as Watt's "Beelzebub" itself It was the well-known ironmaster John Wilkinson who first used a long stiff cylindrical bar fitted in bearings and provided with a cutter head of large size which could be traversed along the bar by means of a rack and pinions It is possible the old boring bar at the Science Museum, South Kensington, was one of Wilkinson's earliest and was used at Bersham Another improvement was the use of a screw instead of the rack, but it is not certain who made this important addition. Among the engineers of that day was Matthew Murray of Leeds, and it may have been due to him In speaking of the making of the screws, Mr Forward quotes an interesting passage from T Gill's "Technological and Microscopical Repository" of 1830, showing how the lines for the screw were first produced on the bar, how a shallow screw thread was cut by hand, and how this shallow screw was used for completing the cutting.

A REPORT by Mr Leslie Armstrong on recent results obtained by the joint committee of the British Association and the Royal Anthropological Institute for the exploration of caves in Derbyshire appeared in the *Times* of December 22. An undisturbed occupation site at Creswell Crags, opposite a cave, known as Mother Grundy's Parlour, at the eastern end of the ravine, has yielded rude implements of quartzite, more than 1500 flint flakes and implements, a number of bone tools, and numerous bones of pleistocene animals More important, however, are examples of palæolithic art in the form of engraved bones, one a spirited drawing of a reindeer, another a part of a bison with the head, and a third fragment too small for identification The only other undoubted example of palæolithic cave engraving from Britain is that of a horse's head from the Robin Hood Cave, also at Creswell, found by Sir W Boyd Dawkins in 1876 The earliest implements—flakes and hand-axes made from quartzite pebbles of late Acheulean form—were associated with remains of cave lion, cave bear, and hyæna They represent not only the earliest occupation of Creswell, but also the extreme northward extension of early palæolithic man in Britain A considerable interval elapsed between this and the next occupation, which belongs to the Reindeer Period In this stratum were flint tools of Upper Aurignacian type, the engraved fragments of bone, and tools manufactured from reindeer antler and bone A hearth or fire-hole was scooped out in the basement bed and ringed with flat stones Not only does the evidence from the cave earth here indicate continuous occupation from late Aurignacian to Azilio-Tardenoisian times, but it also supports the view which challenges the existence of true Magdalenian culture in Britain, and maintains that there was an independent development of culture here which was free from intrusive Magdalenian influence

THE December issue of *La Science Moderne* contains an article by M Reverchon on "L'Evolution de l'Horlogerie." M Reverchon points out that the mechanical clock was the gift of the middle ages, and its development belongs to the last six hundred years. One of the first clocks made was that constructed for the Cathedral of Beauvais, but the oldest clock still going is that in the Science Museum at Kensington The fourteenth century saw many cathedrals supplied with clocks All of these were fitted with the verge escapement—the first of all escapements—the inventor of which is unknown "Nous sommes ainsi reduits à le saluer comme le soldat inconnu de la chronométrie" The verge escapement was the only one used for three and a half centuries, and even the pendulum clock presented by Huygens to the States General of Holland had it A little later came the anchor escapement of Hooke or Clements, and then others by Graham, Le Roy, Lepaute, Mudge, and others. In his sketch, the author divides the history of the clock into three periods, the second of which opens with the work of Huygens, while the third, "the scientific period," began with the work of Edouard Phillips, who in 1861 published his essay "Mémoire sur le spiral réglant"

MARINE meteorology is dealt with in the *Marine Observer* for December published by the Meteorological Office, Air Ministry, this completes Vol. I, which commenced with 1924 The publication emanates from the Marine Division; communications are contributed by the marine staff, and interesting

items are given by the voluntary marine observers, for whose benefit the work is primarily undertaken "Wireless and Weather, an Aid to Navigation," has been made a special feature throughout the year, and the December number is of special interest to seamen, dealing with phenomena common to the Atlantic and Pacific Oceans A quotation is given from "Physical Geography of the Sea and its Meteorology," written by Maury about sixty years ago, given apparently to show that over the open ocean there are no interfering causes as commonly exist over land With our present knowledge of the weather, the North Atlantic with its cold Arctic current flowing southwards and the Gulf Stream flowing northwards, together with other interfering causes, it is not easy to admit that over the ocean "the agents which are at work are of a more uniform character" Synchronous weather charts are given, drawn at sea from wireless reports received, and these will prove very helpful to other observers wishing to obtain similar information It is only recently that it has been possible to draw weather charts at sea, of similar use and with somewhat equal accuracy to the synchronous charts drawn on shore at special weather bureaux A retrospect of the results given in the first volume and the interest in the work taken by seamen is said to justify the continuance of the publication Without doubt marine observers are regaining their pre-War interest in meteorology

AT the twelfth annual meeting of the Indian Science Congress to be held at Benares under the auspices of the Benares Hindu University on January 12-17, His Highness the Maharajah of Benares will be the patron and Dr M O Forster, Director of the Indian Institute of Science, Bangalore, will be the president The Sections and their presidents are as follows — *Agriculture*, R S Finlow, Director of Agriculture, Bengal, Dacca, *Physics and Mathematics*, Prof E P Metcalfe, Principal, Central College, Bangalore, *Chemistry*, Dr J C Ghosh, University professor of chemistry, Dacca, *Zoology*, Dr Baini Prasad, Officiating Director, Zoological Survey of India, Calcutta, *Botany*, Prof R S Inamdar, University professor of botany, Benares Hindu University, *Geology*, Dr G E Pilgrim, Superintendent, Geological Survey of India, Calcutta, *Anthropology*, Prof P C Mahalanobis, Presidency College, Calcutta, *Medical Research*, Lieut-Col F P Mackie, Director of the Bombay Bacteriological Laboratory, *Psychology*, Dr N N Sen Gupta, professor of psychology, Calcutta University Besides the usual sectional programme, general discussions have been arranged on the following topics The physical and chemical aspects of valency, the true path of industrial development in India, the relation of insects to disease in man, animals and plants, the fauna and flora of Krusadai Island near Rameshwaran Popular evening lectures will be delivered by Prof A J Turner, on "Science and the Cotton Industry", by Dr S N Gore, on "Bacterial Flora of Drinking Water in India", and by Prof P Sampat Iyengar, on "The Growth of India" Lieut-Col F P. Mackie will give a cinema demonstration on malaria and kindred subjects A number of excursions and social functions are also being arranged in connexion with the Congress

SIR OLIVER LODGE has accepted the presidency of the Radio Society of Great Britain in succession to Dr W H Eccles, who has held the office for the past two years

WE much regret to record the death on December 26 of Dr G D Liveing, F R S, president of St John's College, and formerly professor of chemistry in the University of Cambridge Dr Liveing, who reached the advanced age of ninety-seven years on December 21 last, was the victim of an accident some two months ago and he never recovered His early work was chiefly in the domain of spectroscopy, and he was awarded the Davy Medal of the Royal Society for his contributions to that subject so long ago as 1901

PROF E GOURSAT, of the faculty of science of the University of Paris, and Prof L Bianchi, professor of analytical geometry in the University of Pisa, have been elected associates of the section of mathematical and physical science of the Académie royale de Belgique (Classe des Sciences); and the Lamarck Prize (Zoology) has been awarded to Prof E Chatton, professor of general biology in the University of Strasbourg

THE University of Sydney commemorated on October 23 last the centenary of the publication of Sadi Carnot's "Réflexions sur la puissance motrice du feu" Representatives of almost all the scientific and educational institutions of Australia were present at the commemoration Lectures on the bearing of Carnot's work on modern science and industry were delivered by Sir Henry Barraclough and Prof O U Vonwiller, and exhibitions and demonstrations of modern oil, gas, and steam engines and refrigerating machinery were given in the Engineering Laboratory of the University

IN conjunction with the Meteorological Office, Mr S Morris Bower, Langley Terrace, Huddersfield, purposes to continue, during this season (January 1–March 31), the annual record of winter thunderstorms in Great Britain hitherto made by Mr C J P Cave, of Petersfield (see NATURE, December 30, 1922, p 877) Reports from all parts of the country are desired, especially from Scotland, Ireland and the North of England

THE last meeting of the Illuminating Engineering Society was held at the E L M A Lighting Service Bureau—an interesting departure with the view of bringing practice and theory into line Visitors, including representatives of gas lighting interests, had an opportunity of witnessing demonstrations of the latest types of lighting units and examining critically methods of impressing the benefits of good lighting on the public Some of the appliances shown illustrated aptly the application of scientific principles in the lighting industry, and there was one device, a new form of camera shown by Dr Rosenthal, that excited considerable interest This compact form of

camera is expressly designed for taking photographs by artificial light and is provided with an exceptionally large aperture It was stated that an exposure of two seconds was sufficient with illuminations not less than 5 foot-candles—a speed that would easily enable photographs of artificial lighting installations to be taken with figures in the foreground In the case of factories, this is likely to be a considerable advantage

KING EDWARD'S HOSPITAL FUND for London has arranged a series of evening popular science lectures, by distinguished scientific workers, during January, February, and March The lectures are to be given at the Imperial College of Science and Technology, King's College, Birkbeck College, and various polytechnics spread over London, and the proceeds go to the Hospital Fund. Sufficient guarantee of the interest of the lectures is given by the list of lecturers Sir Sidney Harmer, Sir Richard Paget, Bart , Sir Robert Robertson, Profs Winifred Cullis, A O Rankine, S Chapman, E W MacBride, C S Myers, G Elliot Smith, E N da C Andrade, J S S Brame, F J Cheshire, and Leonard Hill, Mr W E Garner, Mr C R Darling, Capt P P Eckersley, and Major R W Mayo Tickets can be obtained from the secretary of the institution at which a lecture is to be held, or from the secretary of King Edward's Hospital Fund for London, 7 Walbrook, E C 4 (price 1*s*); serial tickets, available for any number of the lectures (price 4*s*), can also be obtained at the latter address Admission is by ticket or payment at the entrance

"THE Abridged Scientific Publications from the Research Laboratory of the Eastman Kodak Company" is in future to be issued annually because of the increasing number of the publications that have to be dealt with The seventh volume that has just been received gives, in a slightly abridged form, the 22 papers that were printed during 1923 in various English, American, and French scientific journals The full reference is given to the original source in each case, so that any one specially interested in any particular paper may refer to the full communication. The abridgments are classified under the headings of physical optics, photographic optics, inorganic, organic, physical and colloid, and analytical chemistry, photographic theory, and practical photography They carry forward the work for which this Laboratory has become so well known

THE Cambridge University Press announces for early publication "Scientific Papers," by the late S B McLaren, dealing mainly with electrodynamics and natural radiation The work has been prepared for publication by Profs H H Hassé, T H Havelock, J W Nicholson, and Sir Joseph Larmor The same firm also announces "Plant Life on East Anglian Heaths," by Dr E P Farrow The volume will contain an account of some observations, problems and experimental work relating to the ecology of the vegetation of the East Anglican heath district known as the "Breck Country"

"THE Scientists' Reference Book and Diary," published by Messrs Jas Woolley, Sons and Co , Ltd , 76 Deansgate, Manchester, is as attractive and handy a book as any scientific worker could desire It includes useful information, constants, and conversion tables, relating to many branches of science, lists of universities and scientific institutions, mathematical tables, and much other matter, in addition to a diary for 1925 and several detachable pages of squared paper The price of the publication is 3*s* 6*d* , and we can confidently recommend this twenty-seventh issue to all science teachers and students

Our Astronomical Column.

A NEW COMET ?—A telegram from the Copenhagen Astronomical Bureau announces the discovery of a nebulous object by Prof Wolf at Konigstuhl Observatory on Dec 23^d 8^h $15{\cdot}7^m$ G M.T Its R A was 4^h 8^m $19{\cdot}47^s$, N Decl 24° 31′ 36″ (referred to equinox of 1924 0) , daily motion −28 sec., south 14′ , magnitude 16·0

Two plates were exposed by Mr G Merton with the 30-inch reflector at Greenwich on Dec 26, but up to the present, the object has not been located upon them It is clearly beyond the reach of ordinary instruments

VARIATION OF LATITUDE —The *Japanese Journal of Astronomy and Geophysics*, Vol 2, No 3, contains a discussion by H Kimura of the results obtained at the international latitude stations, Mizusawa, Carloforte, and Ukiah, in the last two years The star-places and proper motions have been rediscussed , the amplitude of the combined wave during the period discussed is about 0 2″, that of the *z* or Kimura term about 0 05″

The author concludes that there is a 19-year term in the variation, and that the following sub-multiples of this period have sensible coefficients $\frac{19}{20}$, $\frac{19}{19}$, $\frac{19}{18}$, $\frac{19}{17}$, $\frac{19}{16}$, $\frac{19}{15}$, $\frac{19}{14}$ The second and fifth have the largest coefficients These are the well-known annual and 14-month terms He further believes that terms found in earthquake analysis appear also in the polar motion, indicating a close connexion between the phenomena

CONVECTION CURRENTS IN THE ATMOSPHERES OF THE SUN AND STARS —The Proceedings of the National Academy of Science, Washington, for September 1924 contains a paper by C E St John and H D Babcock on this subject They confirm previous conclusions that the pressure is a small fraction of an atmosphere, being 10^{-1} atm at the photospheric level, 10^{-4} at 5000 km , and 10^{-13} at 14,000 km The daily rotations at these heights are 13 84°, 14 44°, 15 4° , and the linear velocities 1 97, 2 06, 2 18 km /sec The convection currents are downward 0 5 km sec at 14,000 km , downward 0 3 km sec at 1500 km., and upward 0 3 km./sec near the photosphere The authors have made a similar examination of the spectra of Sirius, Procyon, and Arcturus , they conclude that the difference of convection speed for high level minus low level increases with temperature, being 1 20 km /sec for Sirius, type A, 0 67 for Procyon, type F, and 0 34 for Arcturus, type K It may well amount to 4 km /sec for type B, which would explain the well-known "K" term for these stars The pressures in the atmospheres of Sirius, Procyon, and Arcturus are concluded to be of the same order as that in the sun , the largest value found is 0 4 atm

Research Items.

Heredity in Finger Prints.—Attention was first directed to the indications of heredity in papillary ridges by Galton, upon whose investigations our knowledge of finger prints is based. His evidence on this point consisted of a statistical treatment of 150 fraternal couplets, an investigation of 17 sets of twins, and a comparison of children with their parents when both parents were like patterned. Galton himself pointed out that the number of his cases was too few to justify quantitative conclusions. The question has been investigated further by later workers, of whom the most recent is Mlle. Kristine Bonnevie, of the University of Kristiania, who has had the finger prints of the Court of Justice of Kristiania placed at her disposal. This material covers 24,578 Norwegian criminals. The result of an examination of these data is published in the *Journal of Genetics*, vol. 15, pt. 1. The statistical investigation follows Galton's results very closely, showing a percentage for all fingers:—whorls 25.65, radial loops 5.81, ulnar loops 61.14, and arches 7.4, the distribution being characteristic for all fingers. A comparison with material from other races showed the total numerical occurrence of each pattern type to be characteristic of each race investigated, while the distribution of each type upon the various fingers showed in all races the same characteristics as in the Norwegian material. Among other conclusions of considerable importance, a number derived from data furnished by related individuals clearly suggest that finger patterns are hereditary. Further, there is seen to be a causal connexion between the appearance of the patterns and the shape of each finger-ball.

The Culture of the Newars.—The Newars form the most numerous group of the inhabitants of the Valley of Nepal proper, and afford an interesting example of the effect of a fusion of cultures—a point of view from which they have been studied by Mr. K. P. Chattopadhyay in a communication in the Journal of the Asiatic Society of Bengal, N.S. vol. xix. pt. 10. They are divided into the Bauddhamārgis who worship Buddha, and the Sivamārgis who worship Siva; but since their conquest by the Gurkhas, who entered Nepal in 1768, the former have, under the encouragement of their conquerors, lost ground to the latter, who may be termed Hindus, and have an organisation similar to that of the Hindus of the plains, though of a simpler character. The Bauddhamārgis are divided into three grades. A peculiarity of the castes is that most have a religious duty to perform at the festivals, and are as much religious organisations as social. Among the Hindu Newars, the only definite secular occupation followed by any caste except fighting, trade, and cultivation, is that of cowherds. All other occupations are followed by pure and mixed Bauddhas. It is clear that the employment of cattle was not known to the Newars in ancient times, and even now is comparatively rare. Before the knowledge of cattle was introduced to Nepal, a culture characterised by knowledge of metal, wood and stone working, as well as hoe cultivation of a peculiar type, existed, and must have come from elsewhere, being imposed on a country inhabited by rude and wild tribes. An analysis of religion, social organisation, and arts and crafts indicates that this early culture came from India, and not Tibet as has been suggested. This was followed by a later Brahmanic conquest or incursion with a culture not strikingly superior to that of Nepal, into which it was assimilated. It differed in type from that Brahmanic civilisation which affected the Gurkhas.

British Fossil Elephants.—In *La Nature* for November 15 (No. 2641), Dr. Georges Pontier gives an account of his researches on the British fossil elephants. He figures selected specimens attributed to *Elephas planifrons*, *E. meridionalis*, *E. antiquus*, *E. priscus*, *E. trogontherii* and two forms of *E. primigenius*. In a table at the end he sums up his views of the evolution of the group as exemplified by the British forms, and in these views he follows very closely those of Depéret and Mayet, whose paper published in *La Nature* for August 25, 1923 (No. 2577) has already been noticed in these columns (Nature, September 15, 1923, p. 405). While the view, which we owe to Depéret and Mayet, that the various species of elephants form separate lines, with little or no connexion with one another; that, for example, *E. planifrons* gave rise to *E. meridionalis* and its mutations only; that *E. antiquus* is separate from it and so on, is a view which is attractive and easy of comprehension, it is nevertheless not entirely borne out by a closer survey of all the material in the numerous large collections in Great Britain. It takes no account of the many apparent intergradations of the pattern and other characters of the molar teeth which have led many other authors to the different conclusion that there is much interrelationship. It places also too great a reliance on the supposed correctness of the sequence in time of the described mutations, some of which can be shown to occur in England in the same beds instead of appearing in subsequent strata. The paper, however, forms an interesting and valuable contribution to a very perplexing problem.

North American Mammals.—Mr. G. S. Miller has a two-fold object in drawing up his List of North American Recent Mammals, 1923 (Bull. U.S. Nat. Mus., No. 128): to direct attention to the richness of the United States National Museum collections, and to furnish a summary of the systematic results of the study of North American mammals to the end of the year 1923. The stupendous nature of Mr. Miller's task may be gauged from the fact that the United States National Museum collections contain 166,000 skins, three-quarters of which have been brought together by the United States Biological Survey, to the work of which Mr. Miller pays full tribute. The completeness of the collections may be judged when it is remembered that out of 2554 forms represented in North America, only 171, or less than 7 per cent., are absent from the national collections, while the number of types at the disposal of the author was 1435. Mr. Miller has furnished under each species or sub-species a reference to the first publication of the name, or to the publication in which it was first admitted to the North American list, and he has correlated his nomenclature with previously published lists. Under each form the type locality is given with great exactitude, and the known range briefly indicated. Mr. Miller's paper will be an invaluable work of reference for all engaged in the study of mammalogy.

A Problematical Organ in the Lamprey.—Mr. G. R. de Beer (*Jour. Anat.*, vol. lix. pt. 1, pp. 97-107, October 1924) has investigated the problematical organ in the olfactory capsule of Petromyzon first made known by W. B. Scott, and the subject of much speculation by subsequent workers. The organ is vesicular, the vesicles being closed, lined with ciliated glandular cells, containing fluid, and immersed in blood sinuses innervated by branches of the olfactory nerve. The diverticula from which the vesicles

arise in the larva contain secreted (excreted) matter, and the fluid in the adult vesicles is evacuated through the blood There is not sufficient evidence to indicate the homologies of the organ, but the author thinks the evidence not strong enough to warrant the suggestion that it is the homologue of Jacobsen's organ He inclines to the view that it is a gland, possibly endocrinal in nature, the secretion being carried away in the blood sinuses with which it is surrounded Experimental tests with extracts from the organ give negative pituitary reactions No similar organ was found in the allied genera Myxine or Bdellostoma.

A DEVONIAN PLANT WITH ALGAL ORGANISATION AND TETRADS OF RESISTANT SPORES —This interesting conjunction of characters seems to be present in *Sporocarpon furcatum*, a fossil plant from the black shale of the Devonian strata of Ohio, first described by Sir William Dawson, who saw in these saccate, flattened pellicles, the compressed remains of the sporocarps of some unknown plant The late Dr R Kidston and Prof W H Lang now report, in the Transaction of the Roy Soc of Edinburgh, vol 53, pp 597-601, the finding of tetrads of spores in specimens of this plant The authors conclude that the mode of occurrence, general appearance, and structure of the specimens strongly suggest that they are the more persistent tips of some thalloid Alga of the period The disposition of these spore tetrads might be paralleled among living Rhodophyceae, but the resistant nature of the thick wall of the spores and the presence of surface marking corresponding to the place of contact of the spores then become features of extraordinary interest, as they are not found in any known Alga

THE IMMUNITY OF APPLE STOCKS FROM WOOLLY APHIS —In the *Bulletin of Entomological Research* for November 1924 (vol xv pp 157-170), Mr L N Staniland attempts to explain this immunity in certain apple stocks It is well known that the woolly aphis induces gall formation on its host plant, and Mr Staniland remarks that the cambium is affected, almost certainly by the salivary secretion of the insect, in such a way that each of its cells divides more rapidly than normally, thus producing the gall tissue Later, the medullary rays are affected and also contribute to gall formation. The occurrence of sclerenchyma in the host-plant plays an important part in relation to the susceptibility of different varieties of apple to woolly aphis attack The chances of the stylets of the aphid reaching a point near to the cambium bear a definite relation to the degree of development of the prohibiting factor, sclerenchyma The latter tissue, to a large extent, affords a barrier to the passage of the stylets There is also a definite relation between the possibilities of penetration and the number of thin-walled "penetration areas" between the masses of sclerenchyma When the masses of the latter are large, and the softer penetration areas between them are reduced to a minimum, the chances of successful attack are enormously reduced Among the varieties of apple studied it was found that a series arranged according to degree of susceptibility of attack largely corresponds with one arranged in order of the completeness of the development of the sclerenchyma ring

GEOLOGY OF THE GOBI —The geological results of the Asiatic Expeditions of the American Museum of Natural History include a detailed study of the basin structures of Mongolia, a first instalment of which is presented by C P. Berkey and F K Morris in the Bull Am Mus Nat Hist, vol li, 1924, pp 103-127 Between the Arctic and the Pacific divides lies the Gobi Basin, a down-warped plateau bounded by rims that stand some 3000 feet above its average level Within it are many minor basins that the authors distinguish by the term *talas* (Mongol for "open steppelands") Each of these in turn contains still smaller basins which are the *gobis* proper of the Mongols The basement rocks make up a deformed complex that probably corresponds on the whole to the Archæan of other lands, and in particular to the T'ai Shan complex of China Above these there are probable representatives of the Middle and Upper pre-Cambrian, and all are cut by an immense bathylith Next come infolded remnants of Carboniferous and Permian marine sediments, and a more extensive series of continental clastics that seem to be of Lower Jurassic age All these older formations were strongly folded and worn down to a mature peneplain before the nearly horizontal basin sediments were deposited These belong to the Cretaceous and Tertiary, and represent a continuation of continental conditions that have persisted right down to the present day Two types of Gobi basins are recognised, one characterised by a faulted margin on the south, where the basins abut against the fault-block ranges of the Eastern Altai, and the other by simple down-warping in the less disturbed areas The faulted basins contain lavas and a much greater thickness of sediments than the warped basins, but in both types sedimentation was intermittent, and in any one basin long intervals are unrepresented by deposits The Miocene, for example, is almost completely absent from vast areas of Asia On the whole, then, the Angara-Gobia continent seems to have been stable for long periods, and to have suffered regional denudation ever since the (?) Jurassic folding Complementary sedimentation within its own borders is registered only where gentle warping and marginal faulting provided temporary collecting basins

AUSTRALIAN CHINA CLAYS —Australia has large deposits of china clay, and a report has been prepared on their different qualities ("Australian Clays in the Manufacture of White Pottery Wares," by R C Callister, Bull 27, Institute of Science and Industry, Commonwealth of Australia, Melbourne, 1924) The results are presumably of a preliminary character Most of the china clay employed in the work was from Lal Lal, and it is said that in this locality "very large quantities were available of a very uniform composition, later it was proved that this uniformity was further increased" when the material from the top was not mixed with that from below, but analyses justifying these statements are not included The ultimate composition is not far removed from that of some of the English china clays The statement that the osmose process of purification has been condemned in America, may convey a wrong impression Very elaborate and expensive trials on the process have also been made by the British Refractories Research Association, and a few extracts from the report were indicated by Mr S R Hind in the *Gas Journal* (Supplement, July 9, 1924). The net result showed that the expense did not justify the results obtained by this mode of purifying fireclays Several countries have deposits of good china clay near at hand, and yet many manufacturers prefer to import the Cornish clays, *e g* Germany, the United States, etc Manufacturers have stated that they prefer Cornish clays because (i) their uniformity can be depended upon from year to year, and (ii) with other clays there are small losses in manufacture which are a constant and irritating dead-charge on the output It is to be hoped that the Australian china clays will prove an exception

AUSTRIAN METEOROLOGY —In the year-book for 1920 of the Zentralanstalt fur Meteorologie und Geodynamik in Vienna, Dr F M Exner directs attention to the number and distribution of meteorological observatories in Austria There are now 86 observatories, of which 16 are of the first class The year-book gives the full daily observations at Feldkirch, Salzburg, Sonnblick, Vienna, Graz and Obir, and the monthly and year means for all stations Further tables give additional data for Vienna from self-registering instruments, while the final section gives the records of air movements derived from pilot balloons at Vienna in 1919 and 1920, to which are added some data from the Hochobir observatory in Carinthia at an elevation of 6700 feet

FREQUENCY OF HEAVY RAIN IN INDIA —Memoirs of the Indian Meteorological Department, vol xxiii pt 8, gives much valuable data by Sir Gilbert T Walker, who was until recently Director-General of Observatories The object of the discussion is to supply engineering and other projects dependent upon rainfall with trustworthy information regarding both the frequency of heavy rain over various districts of India and the maximum amount of rain to be expected within definite short periods The observations are for all rain-gauge stations maintained during the period of 30 years from 1891 to 1920, using data only where records are available for at least 10 years, and the number of years is stated The falls are given for 24 hours, ending at 8 A M, for the amounts of 3 to 4 inches, 4 to 5, and for each inch to 15 inches, while information of falls exceeding 15 inches in 24 hours is given as footnotes to the ordinary tables. To test the accuracy of the 30 years' limit, frequency tables have been compiled for 8 stations using all available data, the Madras observations cover a period of 85 years and Bombay 76, both of which show the 30 years' results to be quite satisfactory The tables are grouped for the several divisions At Cherrapunji, where there are two rainfall stations, the records extend over 30 years, these show a fall of 39 to 40 inches in the 24 hours, and 5 other falls between 30 and 35 inches, while there are in addition 25 falls between 20 and 30 inches in the 24 hours There are more than ten other stations with a rainfall of upwards of 20 inches in the 24 hours Rainfall frequencies at five stations in the south of the Bombay Presidency are given in an appendix, these are said to bear out Blanford's statement "that the greatest quantity of rain is yielded by falls not differing very much from those of average measurement" Reference is made to Part 7 of the same volume, which gives the monthly and annual rainfall amounts for all Indian stations to the end of 1920 (See NATURE, June 7, 1924, p 836)

MEASUREMENT OF RADIO FREQUENCY —A paper (No 489) of more than ordinary interest on the measurement of radio frequency by Grace Hazen and Frieda Kenyon has been published by the Bureau of Standards at Washington A direct comparison is made between the accurately known frequency of a tuning fork and a high radio frequency Two intermediate radio frequency generating sets are employed and the adjustments are made by noticing the Lissajous figures produced in a cathode ray oscillograph The tuning fork had a frequency of 1024 2 periods per second and was driven by a five-watt electron tube generating set The intermediate generating sets each used a 250-watt electron tube The oscillograph had a tube of the cold cathode type and required about 20,000 volts to operate it. The Lissajous figures were formed on the fluorescent screen by applying the two alternating magnetic fields at right angles to one another. The procedure adopted was to adjust the frequency of the first intermediate set to be a known multiple of the audio frequency A range from 1·5 to 22 times the audio frequency was thus obtained The second intermediate set was then adjusted to the first intermediate set in a similar way Finally a point on the scale of the high frequency meter was found The range of the wave meter standardised in this way extends from 3 5 to 5000 kilocycles per second Photographs of the figures obtained and the apparatus used are given in the paper The method seems to have been first used by L M Hull in 1919 The limitations of the accuracy attainable appear to be entirely in the audio frequency source used as the basis of the measurement and in calibrating and reading the wave meter

THE ELECTRICAL CHARGE OF THE EARTH —In a paper in the *Annalen der Physik* for October, Dr C Ramsauer directs attention to the fact that, though the surface density σ can be deduced from the potential gradient in the atmosphere by means of the formula $2\pi\sigma = -dV/dh$, a direct measurement requires a definite reference point, which can now be supplied by the state of an electrically neutral atom, containing an equal number of electrons and of protons. This is the state in the interior of every conductor, independently of the distribution of electricity on its surface, and an experiment is described in which an insulated plate A, parallel to and in the plane of the earth's surface, can be covered with a conducting cover B connected to the earth, so that A, which was originally part of the earth's surface, is now in the interior of the earth A is connected to earth through a circuit containing a galvanometer and a key The key is pressed down with B removed, the key is raised, B is placed over A, the key is pressed down and the charge on A discharged through the galvanometer Another current can be produced when the cover is removed and A becomes charged again. It is possible to use an electrometer instead of a galvanometer, if the capacity of the condenser A – B is known In this way, the excess of electrons for a definite area of the earth's surface is determined, the highest value observed was about 1×10^{10} electrons or 15×10^{-10} coulombs per square metre; on one occasion, during a light shower, the density fell from 14×10^{-10} coulombs per sq. m. to zero in a few minutes Such variations are due to space charges in the atmosphere, and possibly to the charges of the heavenly bodies.

ZIRCONIUM AND HAFNIUM OXIDES —G. Hevesy and V Berglund have determined the densities of zirconium and hafnium oxides by the pyknometer method (J Chem. Soc, November) X-ray examination showed that the latter oxide contained less than 0·5 per cent of the former, both oxides were prepared from the normal sulphate and were carefully purified. The average densities obtained were (20°). ZrO_2 5·73, HfO_2 9 67, hence the percentage of hafnium oxide in a mixture of the two oxides is given by the formula $(d - 5\ 73)/0\ 0394$, where d is the density of the oxide mixture at 20° This formula should only be used when both oxides are prepared by exactly the same method

ERRATUM —In a note on Mr J B. Kramer's paper entitled "An Electronic Battery," in the issue of December 13, p 873, it was stated that the terminal connected to the carbon is negative, this is incorrect —the terminal connected to the zinc is negative, and that connected to the carbon positive.

Cloud Forms.

THE United States Weather Bureau at Washington has issued a publication [1] which would seem to be intended as a guide to cloud forms for meteorological observers It consists of a short introduction, two diagrams of cloud height frequencies, a page devoted to definitions of cloud forms, taken from the International Cloud Atlas, and 32 photographs of different forms of cloud The memoir gives in convenient form information which will be useful to meteorological observers, and if any criticism may be made, it is that a few of the photographs are not quite typical and some are not clear

All modern cloud classification is based on the International Cloud Atlas The classification adopted there is based on appearance It is also recognised that form has been found to be largely dependent on height, and American observers argue that "it is therefore possible to gain information concerning the direction and velocity of the wind aloft by assigning the cloud to the height of most frequent occurrence, even though its exact height at the particular time is not known" This method has been widely used, but it has always seemed to the writer to be a procedure of very doubtful validity, especially when applied, as it frequently has been, to cirrus, for although, as we learn from the Weather Bureau Memoir, "the height of maximum frequency both summer and winter was between 8000 and 8400 metres," out of 227 measurements, yet there was a secondary maximum some 2000 metres higher "Seven-tenths of all cirrus observed were found between 7600 and 11,200 metres," which is a fairly wide range, while cirrus has apparently been observed at Blue Hill, Mass, so low as 2400 metres and so high as 15,000 metres

The method of assuming cloud heights and deducing the wind velocity at the cloud level by observing the drift is therefore liable to grave errors, the one theodolite method of observing pilot balloons has been much criticised on the same grounds, but on days when convection currents are not very active, it is not so liable to error as the cloud method One can never be certain without cloud height measurements that one is dealing with a cloud at an average height

The consideration of the maximum height of cirrus brings to mind the so-called "night shining clouds" observed in the last two decades of the nineteenth century, supposed to be associated with the eruption of Krakatoa They had all the appearance of cirro cumulus, but their height was about 50 kilometres The highest cirrus measured by A. W Clayden was $27\frac{1}{2}$ kilometres, there is thus a region of more than 20 kilometres in which clouds have never been observed, and then a level where they have been observed on rare occasions Perhaps it is more than a coincidence that the height of the night shining clouds corresponds with the secondary or lower maximum of meteor disappearance as determined by Lindemann

The two diagrams reproduced here (Figs 1 and 2) give cloud height frequencies for the various forms of cloud, for summer and winter respectively, as observed at Blue Hill, Mass, based upon tabulations for each 400 metres, by H H Clayton These diagrams are extremely interesting, and we wish that similar diagrams could be constructed for other parts of the globe, there must be a considerable body of information which might be made available, for there are to-day more methods than formerly of determining cloud heights The diagrams show very clearly over what a wide range of height the various cloud forms

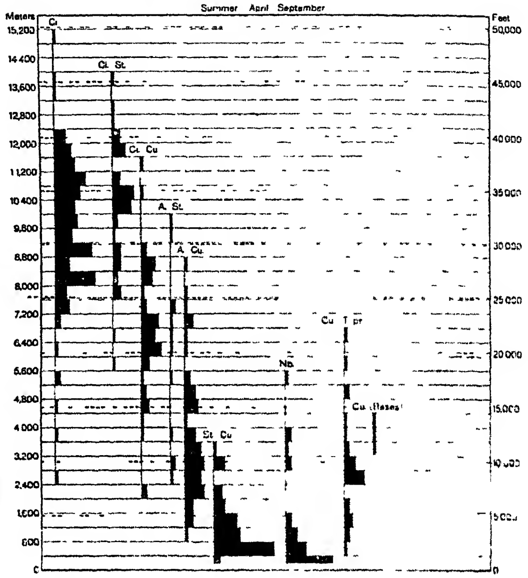

FIG 1 —Cloud height frequencies, April to September, 1890-91 and 1896-97, Blue Hill, Mass, based upon tabulation for each 400 metres, by H H Clayton Relative frequency is indicated by width of figure From "Cloud Forms"

extend, alto cumulus overlaps cirro cumulus, and strato cumulus overlaps alto cumulus, and one is tempted to wonder whether there is any essential difference between the three forms, since neither in

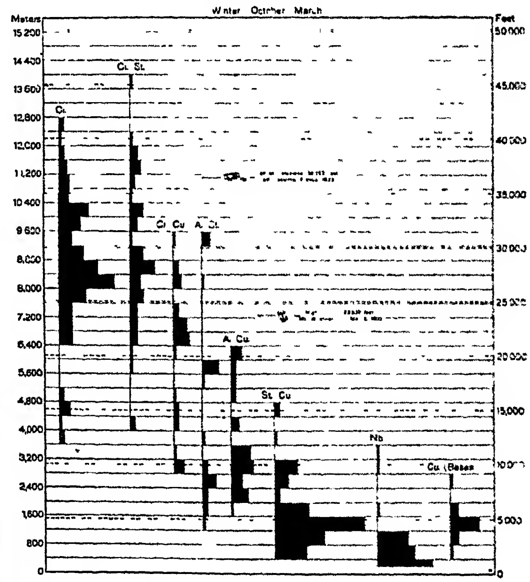

FIG 2 —Cloud height frequencies, October to March, 1890-91 and 1896-97, Blue Hill, Mass, based upon tabulation for each 400 metres, by H H Clayton Relative frequency is indicated by width of figure. From "Cloud Forms."

[1] U S Department of Agriculture, Weather Bureau "Cloud Forms according to the International System of Classification" Prepared by the Weather Bureau Cloud Committee Benjamin C Kadel, Harry C Frankenfield, and Franklin G Tingley Pp 22 (Washington Government Printing Office, n d) n p

appearance nor in height is there any line of demarcation This is indeed recognised, for in one of the photographs, illustrating the Weather Bureau publication, of strato cumulus or alto cumulus, a note is added that "these same clouds would be called strato cumulus by an observer nearer to them and alto cumulus by an observer farther from them (as at sea level)" The heights given for nimbus are curious, the maximum frequency is quite low, 400 metres for both summer and winter, but there are occasional observations at higher levels, one in summer so high as 5000 metres

The photographs which constitute the bulk of the Weather Bureau Memoir are interesting, and some, such as the undulated alto stratus seen from above at Mount Wilson (Plate 11), and the same form of cloud seen from below at Washington (Plate 13), are very beautiful There is one remark to which exception might be taken, it occurs as a note under a fine photograph, by Sir David Wilson-Barker, of small alto cumulus, and runs "Even if there are no shadows the presence of coronas or iridescent colours near the sun or moon distinguish such small alto cumulus from cirro cumulus" In the present writer's experience, iridescence and coronæ are quite common in clouds which would be classified as cirro cumulus

The Locust Problem and its International Solution.[1]

By Dr A. D Imms

It is a matter of common knowledge that the damage occasioned by locust invasions is frequently extremely serious Thus, in the year 1874, the destruction brought about by these insects in the Rocky Mountains amounted to approximately forty million dollars In 1908 an estimated damage of one million sterling was caused by locusts to crops in the Transvaal, while the cotton crop in Egypt has often suffered severely The intensity of an attack, and some idea of the damage done, may be gauged from the number of locusts often found within a comparatively small area For example, in Southern France in 1920, between twelve and thirty million locusts were destroyed daily, while twenty tons of eggs were collected in a single month in the Argentine in March 1915 Since the year 1914 the countries affected by locusts include the greater part of Africa, certain parts of Spain, France, Italy, Asia Minor, Turkestan, etc The regions more especially affected lie between 20° and 40° latitude north and 15° and 45° latitude south, the equator being comparatively immune In order to deal with these outbreaks some international organisation appears necessary, and it is to be hoped that the League of Nations will lend its authority to assist in arriving at a concerted plan of action The need for international action is obvious when it is remembered that locust swarms can travel 18 to 300 miles in a single day, thus easily migrating from one country into another

Very large amounts of money are spent yearly by some countries on preventive measures The danger to public health caused by locust invasion is far smaller than formerly, and the last severe famine due to locust devastation was in 1866 In that year about 200,000 natives perished in North Africa The obstruction and poisoning of wells and other water supplies, however, may still entail very serious consequences

No really adequate biological studies of locusts are available, and knowledge has scarcely yet progressed beyond empirical methods Much that has been written on the migration and breeding of these insects is sufficiently untrustworthy to demand renewed investigation Important work, however, has been done by Uvarov, J C Faure and Hernandez Among the results achieved, the most important is the demonstration that certain species of locusts have two distinct phases in their development the migrating or gregarious phase and the solitary or individual phase Uvarov has devoted attention to the problem of migrations These are not the result, as commonly supposed, of the necessity of finding fresh food Locust swarms frequently leave fertile lands for others which are far less so The factors governing these migrations need renewed study, but they appear to be governed by variations of temperature rather than by the availability of vegetation Important changes in the physiology of the individual locusts have also been observed during migration Until sufficient biological data are available, emergency action will have to be continued in order to restrict migration and the resulting damage to crops It is to be hoped, however, that the problem will be solved if the States interested will provide for the biological investigation of locusts instead of being satisfied with occasional emergency measures

Methods of control are very varied, and it may be added that the utilisation of natural agents has been insufficiently explored The study of the insects' parasites demands further attention, and we are still not in a position to say whether important results may or may not be expected from this line of work Attempts at propagating bacterial or other diseases have not yet been successful Mechanical methods by means of artificial barriers are numerous, and these provide the means for arresting and destroying locusts in bulk but they are not by any means adequate. Physical methods—the use of fire—have been applied in various ways The modern French method of using the army flame-projector has been employed with great success in Algeria A single charge of 12 litres of crude oil is sufficient to destroy all locusts gathered on a surface of 500 square metres Among chemical methods, the use of poison gas has not proved successful in experiments Among insecticides, arsenate of soda appears to be the most satisfactory compound, and in Italy other methods of destruction have now been abandoned

International conventions for combating these insects first came into being in South America and South Africa A further important step was taken at the Rome conference of 1920, when thirty-five countries signed a convention naming the International Agricultural Institute as the headquarters of an International Locust Information Bureau Unfortunately, it does not seem that much progress has been made, and the International Institute has not been in a position to publish reports from the Governments concerned except a few from Algeria, Bulgaria, French West Africa, and Hungary Good work, however, has been done by North African countries, which have concluded a special agreement among themselves It is to be hoped that effect will be given to the resolutions of the 1920 Convention and that the need of financing skilled biological study of locusts will be recognised M Vayssière outlines a scheme of the international organisation he proposes and suggests the League of Nations as being best able to give that assistance necessary to secure effective international co-operation of the kind required

[1] "Le problème acridien et sa solution internationale" By Paul Vayssière, in *Matériaux pour l'étude des calamités*, No 2, 1924, pp 122-158 (Publiés par les soins de la Société de Géographie de Genève)

Fields of Progress in Chemistry.

THE American Chemical Society has started a new venture in the form of a quarterly issue of *Chemical Reviews* The first issue contains four articles. on "Atomic Weights and Isotopes" (40 pp), by Prof T. W Richards, on "The Constitution of Polysaccharides" (31 pp), by Principal J. C Irvine, on "The Theory of Membrane Equilibria" (18 pp), by Prof. F G Donnan, and on "Organic Radicals" (51 pp), by Prof. M Gomberg These four articles were prepared in connexion with the dedication of the Sterling Chemical Laboratory, and are now published as part of the first volume of *Chemical Reviews* by permission of Yale University

Although prepared for another purpose, the articles may perhaps be regarded as a type to which later *ad hoc* contributions will tend to conform, and may therefore be used as the basis for an answer to the obvious question as to whether a new publication of this kind is likely to be of permanent usefulness In our opinion, the answer is in the affirmative Twenty years ago, in 1904, the Chemical Society of London began a series of Annual Reports on the Progress of Chemistry in order "to present an epitome of the principal steps in advance which have been accomplished in the preceding year", and more recently the Society of Chemical Industry has supplemented this work by a series of Annual Reports on the Progress of Applied Chemistry These annual reports have established themselves as an indispensable supplement and guide to the contents of the Abstracts of the preceding year Their most obvious limitations are found in two directions. The first is a tendency to "scrappiness," which must always result from the cutting up of a continuous series of experiments into yearly "progress reports" The second is the risk that the personal interests of the reporter in a particular branch of chemistry may lead to the over-emphasis of progress in certain directions, and the neglect of important work in others

These limitations have been minimised by changing the reporters after a period of perhaps three years, and by encouraging them to trace in some detail the earlier stages of researches in which important progress has been made during the year, but it is clear that the new series of *Chemical Reviews* will have the great advantages that the articles will deal with a small number only of live topics and that the summaries will be authoritative statements by the worker himself, instead of by a reporter For the general student, who wishes to secure an introduction to current literature, it may very well prove of even greater value than the Annual Reports, and, judging by the earliest samples, they have the merit of being eminently readable, so that it is a pleasure rather than a duty to study them On these grounds the new publication may be heartily welcomed, as providing in a systematic form the type of publicity that has hitherto only been given spasmodically in lectures and presidential addresses The price of the publication is five dollars for each annual volume, or four dollars to members of certain cognate societies, it is also proposed, if there is sufficient demand, to issue reprints of the individual articles, so that a whole class can be supplied with copies.

The International Critical Tables.

AT the meeting of the International Union of Pure and Applied Chemistry held in London in 1919, the American delegates submitted a proposal for the international compilation of critically prepared tables of the physical properties of chemical substances and technological materials The proposal was approved by the Union, and the American National Research Council at Washington has since undertaken the financial and editorial responsibility for the undertaking A Board of Trustees has undertaken to raise the sum of 200,000 dollars or such part thereof as may be necessary The editorial responsibility is invested in a Board of Editors, the editor-in-chief being Dr E. W Washburn, formerly professor of physical chemistry at the University of Illinois

To ensure the international character of the Tables, corresponding editors have been appointed in the principal countries of the world It may be added that the Tables are in no sense a commercial undertaking and the members of the boards of trustees and editors and the corresponding editors serve in an honorary capacity.

The work of critically examining the data and of compiling the various tables is being carried out by well-known chemists, physicists, engineers, etc, some three hundred in number, who have been chosen for this purpose in the various countries of the world, largely on the basis of recommendations from the corresponding editors and their advisory committees These authorities are not being expected to assume the responsibility of searching the literature, a task which is being carried out in the main by the editorial staff at Washington, but rather to assemble, to examine critically, and to select the best value for each constant, indicating at the same time the probable uncertainty. Each portion of the Tables will be published over the name of the co-operating authority who has assumed responsibility for it, and the size of each assignment has been restricted so that the work may be carried out within a reasonable time and without becoming too great a burden for any individual (or co-operating group of individuals) to bear.

The main language employed in the Tables will be English, but the introduction, table of contents, definitions, general explanatory text, and a very complete index will be in English, French, German, and Italian

The Tables will contain all available information of value concerning the physical properties and numerical characteristics of (*a*) pure substances, (*b*) mixtures of definite composition, (*c*) the more important classes of industrial materials, (*d*) many natural materials and products, and (*e*) selected data for certain bodies or systems, such as the earth and its main physical subdivisions, the solar and stellar systems, and certain biological organisms, including man

The scope of the Tables is so immense, and of such an unprecedentedly comprehensive character, that special attention has had to be given to the arrangement so as to enable the Tables to be used with facility and dispatch For pure chemical substances the data will be assembled in tables of properties, but a certain amount of latitude and duplication will be permitted in some instances, and tables of materials will be employed where it proves to be more convenient. In some cases no definite value of a constant can be put down, but only upper and lower limits. In other cases a graph may be the best means of indicating the variation of the particular property in question

The importance of securing uniformity in the case

of fundamental constants, conversion factors, etc, has not been lost sight of, nor the importance of associating, where possible, with the data for a particular specimen or material, a statement of the exact experimental conditions, life history, etc

The Tables will be issued in a series of volumes comprising a total of about 2500 pages (10 in ×7 in), publication extending over about a year and a half. The progress made has been such that the first volume is now in the press and may be expected during the early months of 1925 The published price of the Tables will be from 60 to 75 dollars for the set, but the trustees are reserving the privilege of purchasing from the publishers at the rate of 35 dollars per set whatever number of sets may be required to fill all advance subscriptions received by the National Research Council of America up to a definite fixed date, probably April 1 or May 1, 1925 This price represents only the cost of printing, but the trustees and the National Research Council are anxious that all scientific men and women shall be given the opportunity of taking advantage of the lower rate Accordingly, arrangements are being made so that (1) members of a recognised scientific, technical or engineering society, or (2) universities, research laboratories, libraries, government departments or the like, will shortly be given preferential facilities for purchasing sets at the lower figure before the expiration of the above-mentioned date. The National Research Council will deal with such applications, but all orders placed in the ordinary way through the trade will be handled by the publishers at the higher figure

The Advisory Committee for the British Empire (excluding British North America) consists of Dr G W C Kaye (corresponding editor), Sir Robert Robertson, Dr W Rosenhain, Prof A W Porter, Dr T E Stanton, Mr. J E. Sears (jun), Mr A. C G Egerton, and Mr. W F Higgins as secretary Dr Rosenhain is also acting as special editor for metals and alloys It is requested that any correspondence from the British Isles with reference to the Tables should be addressed to Dr Kaye, The National Physical Laboratory, Teddington, Middlesex

University and Educational Intelligence.

BELFAST —Dr J A Milroy has been appointed J. C White professor of bio-chemistry in the Queen's University Dr Milroy came to Belfast in 1902 as demonstrator in physiology, and on the foundation of the University in 1909 he was appointed lecturer in bio-chemistry. The title of reader in bio-chemistry was conferred on him in 1922 He is the author of numerous articles in the *Journal of Physiology* and other scientific papers

Dr V D Allison has been appointed J C White lecturer in bacteriology in the University Dr Allison is a graduate of the University, and since 1920 has continued his studies as research student in the Institute of Pathology as a Beit Memorial Research Fellow, working under Sir Almroth Wright and Prof A Fleming

BIRMINGHAM.—Applications are invited for the professorship of philosophy in succession to Prof Moberly. Applications (fifteen copies of each), copies of three testimonials, etc, must reach the Secretary of the University by February 2 at latest

LONDON —The following doctorates have been conferred —*D.Sc* (*Botany*) Miss K B Blackburn (Bedford College), for a thesis entitled "The Cytological Aspects of the Determination of Sex in the Dioecious Forms of Lychnis", *D Sc.* (*Chemistry*) Mr Harold Hunter (East London College and Battersea Polytechnic), for a thesis entitled "The Chemical Significance of Optical Dispersion"; *D Sc* (*Physics*): Mr A. H Davis, for a thesis entitled "Natural and Forced Convection of Heat in Gases and Liquids," and other papers, Mr J. H Shaxby, for a thesis entitled "Papers on Molecular Physics," and other papers; Mr J. E P. Wagstaff, for a thesis entitled "The Measurement of Short Time Intervals and its Application to (*a*) the Determination of the Velocity of Detonation of Explosives, (*b*) the Duration of Impacts of Bars mainly with rounded Ends, in elucidation of the Elastic Theory," and other papers

MANCHESTER —Applications are invited for a lectureship in anatomy The latest date for applications is February 11. They should be sent to the Internal Registrar, from whom particulars may be obtained

OXFORD —Applications are invited from persons possessing a thorough knowledge of entomology in its application to forestry and with experience of tropical conditions for the post of entomologist at the Imperial Forestry Institute Applications, stating age, qualifications, and salary required, and furnishing references and copies of testimonials, with a list, and if possible copies, of published writings, should be submitted not later than April 15, to the Secretary of the Institute.

THE official report of the Indian Universities Conference held at Simla last May (Calcutta, Govt. of India Central Publication Branch, pp 79 8*d*) gives in full the Viceroy's inaugural address, two addresses by the Minister of Education, Health and Lands, and the 49 resolutions passed by the Conference, and brief summaries of the discussions. The most important outcome of the Conference is the project for an inter-university board. Steps have already been taken to bring this into being, a provisional committee having been appointed immediately after the close of the Conference to make further detailed suggestions for the consideration of the universities This it has done, and it is proposed to hold the first meeting of the board in Calcutta, if possible in February next The Conference has, moreover, recommended to the Government of India that a central advisory board for scientific research be constituted in India, comprising the heads of scientific departments of the Government and a representative of science nominated by each of the Indian universities and by the Indian Institute of Science, with power to co-opt representatives of other recognised institutes of science not affiliated to any university It is intended that this Board should, among other things, co-ordinate scientific publications in India, utilising or combining existing organs and developing them on an all-India basis and recommending to Government cases where financial assistance would be desirable It would consider whether the publications of the Indian Museum and the Botanical Survey of India, the Memoirs of the Geological Survey of India, and the *Agricultural Journal of India*, now issued by Government, should not have on their editorial boards expert representatives of the various universities, and whether the scope of these journals should not be enlarged It would also advise the Government from time to time generally with regard to the promotion of scientific research in India Another resolution demands the remission of customs duty on scientific apparatus and chemicals imported for the use of universities and other approved educational institutions

Early Science at the Royal Society.

January 3, 1662/3. The president reported a letter in favour of the society to the duke of Ormonde, lord lieutenant of Ireland —" I am desired by the Royal Society in their names to entreat your grace's favour and countenance in the effectual settlement of the fractions of adventures, arrears, lands, &c, which by the act for the better execution of his majesty's gracious declaration were vested in his majesty, in trust for, and the better to enable his majesty to grant the same to them, so as his majesty being their founder might also be their chief benefactor" . [signed Brouncker, P R S]—Sir William Petty who was then in Ireland, was desired to make a calculation of these fractions of adventures &c, which he accordingly did, but did not send the society the result of it, in regard that interest was past before by patent acts unto some others, as he mentions to Sir Robert Southwell, when the latter desired him, in the name of several of the most eminent members of the society, to send over to them his calculations

January 4, 1664/5 Mr Francis Willughby being come home from his travels [mostly in Spain] and present, was desired to communicate his philosophical observations He produced a printed cut representing Saturn and Jupiter, and what Campani had lately observed in them by means of his new glasses, wrought by a turn-tool without a mold

1666/7 Mr Oldenburg read an extract of Mons Auzout's letter to him from Paris, mentioning a new method esteemed by him better than any hitherto practised, of taking the diameters of the planets to seconds, and of knowing the parallax of the moon by means of her diameter Dr Wren and Mr. Hooke having related to the society several ways, which they had known long before of taking the diameters of the planets to seconds, were desired briefly to describe them, that so it might be signified to the Parisian philosophers, that it was a thing not at all new among the English

January 6, 1663/4. Mr Boyle remarked that swallows frozen up in ice, upon the thawing away of the ice had been found alive, and flying about, and that a minister had sent a certificate of this to the king from Dantzic —Sir Robert Moray related that he had been informed by his highness the Duke of York, that there were certain little springs at Croyden, which would run together, and make a stream for a certain space, and then slide under the ground, and afterwards break out again. Dr Wilkins having acquaintance at Croyden, was desired to make a particular inquiry after this fact

January 7, 1662/3. Mr Bruce brought in an account of windmills in Holland, which was ordered to be registered [We may recall here the reference that was made in NATURE, of Sept 13, to the acquisition by the Franklin Institute in 1922, of a collection of books and pamphlets on windmills, inclusive of treatises on the subject in German and Dutch, 17th and 18th centuries]

January 8, 1661/2. Sir Robert Moray communicated letters, in French, from Mons Frenicle to Mons Huygens, concerning the hypothesis of Saturn —Mr Rooke read a paper of inquiries to be made in the East-India captain's voyage to Bantam —It was ordered that all the papers of inquiries for foreign parts be written out into one paper

1672/3. There was produced to the society a discourse of Dr. Grew, concerning his whole design with respect to vegetables, and the means of effecting it Part of this discourse was read, to the great satisfaction of the Society who urged the publication of it

Societies and Academies.

LONDON

Royal Anthropological Institute, December 9 —H **Balfour** The origin of the art of stencilling in the Fiji Islands The use of stencils in the Fiji Islands, for decorating bark-cloth, does not appear to have been introduced into the group from the outside, and it was suggested that the stencil designs, which are cut in leaves almost invariably, may very probably have been suggested by leaves which have been tunnelled by insect larvæ while still in the tightly rolled up state of the budding leaf The leaves, when they unroll in the course of their development, exhibit transverse alignments of regular perforations, which bear a striking resemblance to some of the simpler Fijian stencil designs

PARIS

Academy of Sciences, November 24 —L **Lecornu** The tetrahedral system Lowthian Bell, in 1875, regarded the earth as possessing a symmetry analogous with that of a regular tetrahedron This question has been examined by several geologists the author submits it to a mathematical analysis, applying the theory given in a recent note (*Comptes rendus*, t 179, 1924, p. 853) on the deformation of a spherical envelope —J and Mlle M **Bordet** The bacteriolytic power of colostrum and milk Colostrum exerts a powerful bacteriolytic action upon organisms commonly present in the atmosphere This confirms the work of Jensen (1905) and of T Smith and Little (1922) —W **Kilian** The fluvio-glacial deposits of the southern bank of the lake of Geneva and their hydrological regime (Evian, Amphion, Thonon) —Jules **Andrade** A curious theorem of metrology and its applications to chronometry —P J **Myrberg**: A generalisation of the linear equations of finite differences.—E F **Collingwood** The exceptional values of integral functions of finite order —Nikola **Obrechkoff**.: The convergence of trigonometrical series.—Paul **Mentré**: The non-special complexes with multiple inflectional focus.—D **Riabouchinsky** Some considerations on the plane rotational movements of a liquid —P **Idrac** Theoretical study of the flight of the albatross in a wind increasing with the altitude.—Charles **Nordmann** and C **Le Morvan** Variable stars with continuous variation and Ritz's hypothesis de Sitter has adduced observations on double stars as evidence in favour of the constancy of the velocity of light La Rosa has criticised these views and concludes that observation of these stars proves nothing for or against the hypothesis of a constant velocity of light. The authors have shown that the amplitude of the light variation of variable stars with continuous variation is not the same in different regions of the spectrum This experimental fact the authors consider invalidates the extension of the ballistic hypothesis of Ritz, as given by La Rosa. —F. **Baldet**. Observations of the planet Mars with the 83 cm telescope of the Meudon Observatory. Reproductions of six drawings of the planet are given, taken between September 5 and 28 All the observations detailed confirm those already published by Antoniadi No trace has been found of the geometrical network of filiform "canals"—J **Guillaume**. Observations of the sun made at the Observatory of Lyons during the second quarter of 1924 Observations were possible on 83 days during the quarter The results are summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude —Rafael **de Buen** Some observations on the course of the currents in the Straits of Gibraltar.—

P. **Gaubert** The circular polarisation of the light reflected by insects Detailed examination shows that the insect behaves as though the cuticle which surrounds it had been cut out of a single sheet of tissue capable of polarising light circularly Two hypotheses are examined, in which the presence of liquid crystals is assumed Cholesterol melts at 147° C, and as the polarisation phenomena do not completely disappear below 300° C, the presence of this substance does not afford an explanation —L **Décombe** Electrified spherical films The direct calculation of the constant of gravitation as a function of the constants of Avogadro, Faraday, Rydberg, and Planck —Ch **Féry** A lead accumulator incapable of being sulphated The fundamental equation governing the working of the ordinary secondary battery is assumed to be

$$2Pb + H_2SO_4 + Pb_2O_5 \rightleftarrows Pb_2SO_4 + 2PbO_2 + H_2O$$

According to this view, lead sulphate, $PbSO_4$, is not formed during a normal discharge The spontaneous discharge of an accumulator on standing is regarded as due to the combined action of oxygen and the electrolyte on the negative plate

$$2Pb + H_2SO_4 + O = Pb_2SO_4 + H_2O,$$

with a secondary reaction

$$Pb_2SO_4 + H_2SO_4 + O = 2PbSO_4 + H_2O$$

To avoid the last reaction it should be sufficient to prevent access of oxygen to the negative plate A description is given of a new form of accumulator designed to fulfil this condition This battery retained 33 per cent of its charge after standing 26 months, corresponding with a discharge of 4 per cent per month If discharged, and allowed to stand two years, it could be recharged normally —Victor **Henri** and C **Teves** The absorption spectrum of sulphur vapour as depending on the constitution of the molecules The molecules S_8 and S_6 present a structureless continuous absorption spectrum The S_2 molecules possess an absorption spectrum formed of a very large number of bands, the structure of which is analysed in detail (*v* also NATURE, December 20, p 894) —M **Bourgeaud** and A **Dondelinger** Researches on the affinity constant of some organic bases —D **Yovanovitch** and J. **d'Espine** The magnetic spectrum of the high velocity β-rays of mesothorium 2 Two of the lines have velocities 0·998 and 0 986, compared with the velocity of light taken as unity —A **Vila** The reduction of sulphuric acid to hydrogen sulphide The vapours of sulphuric acid mixed with an excess of hydrogen and passed over silica at a red heat (700° C to 900° C) give almost theoretical yields of hydrogen sulphide —L J. **Simon** and V. **Hasenfratz** The lactone of *l*-arabonic acid and some of its derivatives —Ch **Courtot** and A **Dondelinger** The α-halogen derivatives of indane —C **Kohn-Abrest** The gases in fresh, putrefied, and frozen blood Application of the method described in a previous paper to the determination of carbon dioxide, oxygen, nitrogen, and sulphuretted hydrogen in blood It is shown that freezing blood not only arrests putrefaction, but also removes some hydrogen sulphide if this has been already produced by putrefaction —Y **Milon** The fauna and the age of the Waulsortian limestones of Saint-Pierre-la-Cour —G **Mouret** The true prolongation, at Bourganeuf (Creuse), of the Argentat fault and the nature of the supposed schists and gneiss of that region —Louis **Barrabé** and Pierre **Viennot** The discovery of an oil-bearing layer at Gabian (Hérault). This boring has been carried to a depth of 107 metres, and the present hourly yield of crude oil is between 500 and 600 litres The oil has a density of 0·846 at 15° C, contains 10 per cent of wax and only traces of asphalte.—Gabriel **Guilbert** The case of destruction of a cyclone —Ph **Schereschewsky** and Ph **Wehrlé** Polar pseudo-fronts —H **Colin** The formation, distribution, and circulation of inulin in the stem of the Jerusalem artichoke —J **Chaze**· Attempts at pure cultures of a Saprolegnia —Marc **Bridel** The presence of very large quantities of free maltose in the fresh tubercles of *Umbilicus pendulinus* These tubercles contain large quantities of maltose as a food reserve, and it has been possible to obtain nearly 4 per cent in the crystalline state This is the first time that maltose has been directly extracted in the crystalline state from plants —R **Cerignelli** Indol in the flowers of Spanish jessamine (*Jasminum grandiflorum*) Indol is a normal constituent of the flowers of this plant —J **Chaussin** Study of the soluble medium and the insoluble tissues in the course of the development of wheat the influence of a complete mineral manure. —Lucien **Daniel** Heredity in grafted plants —M. **Munerati** Contribution to the study of the appearance of sex in dioic plants —L **Mercier** The action of naphthalene vapour on *Calliphora erythrocephala* Study of the microscopic lesions presented by the individuals showing malformation —L **Leger** A new crayfish in French waters —P. **de Beauchamp** The appearance of variations under experimental conditions in rotifers of the genus Brachionus.—R. **Herpin** The swarming of *Perinereis Marionii*. The evolutive cycle of *Platynereis Dumerilii* —Ph **Joyet-Lavergne** The cytoplasmic characters of sexuality in the Gregarinæ —W **Vernadsky** The representation of the chemical composition of living matter —Mlle Eliane **Le Breton** and Charles **Kayser** The metabolism of the purins in diabetes.—Mme L **Randoin** and H **Simonnet** Growth and maintenance of the rat submitted to an artificial diet deprived both of factor B and glucides —C **Dawydoof** The return of *Lineus lacteus* to an embryonic state under the influence of starvation —C **Lebailly** Flies play no part in the dissemination of aphthous fever

VIENNA

Academy of Sciences, November 13 —F M **Exner**. The pressure of sand-hills Attempts have been made to measure the pressure on a plane under-surface of sand masses thrown up with maximum slopes The pressure values in the middle of the base were about those of water columns of the same height, although the density of sand is 1 5 Towards the edges the pressure decreases more slowly than would correspond to the height of the sand This is because the side columns, in consequence of friction, bear part of the weight of the central columns. Hyperbolas drawn between the sloping surfaces as asymptotes correspond to this pressure distribution The idea can be applied to determine the form of the compensation defect masses below sea-level in the theory of isostasy —F. **Pollak** The kinetics of dissolved gases I The evaporation of carbon dioxide from watery solution into a stream of bubbles of an indifferent gas —M **Kohn** and G **Loff** VIII. Communication on bromo-phenols Bromo- and bromo-nitro-resorcin —M **Kohn** and G **Loff** On styphnic-acid-mono-methyl-ether and a new trinitro-guaiacol —M **Kohn** and R. **Lakner** On the action of magnesium-phenyl-bromide on bromo-ethyl-phthalamide —A. **Kieslinger** Report on geological and petrographic researches in the Southern Kor Alps on the boundary of Styria and Carinthia. These include (*a*) old crystalline, Teigitsch series, etc ; (*b*) diaphthorite zone, (*c*) Mahrenberger series, (*d*) Tertiary covering —J. **Kaesz**· Solution of the Deli-problem by compasses and ruler.—H. **Priesner** New Thysanoptera

Official Publications Received.

Ceylon Journal of Science Section A, Botany Annals of the Royal Botanic Gardens, Peradeniya Vol 9, Part 2, November 22. Pp 119-241 (Peradeniya Department of Agriculture, London Dulau and Co Ltd) 3 rupees

Spolia Zeylanica Issued from the Colombo Museum, Ceylon Edited by Dr Joseph Pearson Vol 12, Parts 47 and 48 Pp. 335-408 (Colombo)

Report of the Botanical Survey of India for 1923-24 Pp 13 (Calcutta Government Printing Office)

Appendix No 2 to the Annual Report of the Chief of the Bureau of Navigation, 1924 Annual Report of the Naval Observatory for the Fiscal Year 1924 Pp 25 (Washington Government Printing Office)

The Indian Forest Records Vol 10, Part 5 Analysis of the Tanning Properties of certain Burma *Lagerstroemias* By E Pasupati, reported by J A Pilgrim Pp 28 7 annas Vol 10, Part 8. The Constituents of some Indian Essential Oils Part 13 The Essential Oil from a new Species of *Andropogon* occurring in the Etawah District, U P By John Lionel Simonsen Pp 13 3 annas Vol. 10, Part 10 The Mangroves of South Tenasserim; being an Account of an Investigation of various Products of the Littoral Forests of Southern Burma. By J A. Pilgrim Pp iii+73 15 annas (Delhi: Government Central Press)

Commercial Intelligence Department, India. Agricultural Statistics, 1921-22 Vol 2 Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment, in certain Indian States Pp ii+v+83 (Calcutta Government of India Central Publication Branch) 15 annas, 1s. 6d

Transactions of the Royal Scottish Arboricultural Society Vol 38, Part 2, October. Pp 69-155+27-36. (Edinburgh) 3s

Bulletin of the American Museum of Natural History Vol 50, Art 6 Insect Sounds By Frank E Lutz Pp 333-372 (New York)

The Physical Society of London Proceedings Vol 37, Part 1, December 15 Pp 74 (London Fleetway Press, Ltd) 6s net

Leeds University. Twentieth Report, 1923-24 Pp 104 (Leeds)

Diary of Societies.

SATURDAY, JANUARY 3

GEOGRAPHICAL ASSOCIATION (Annual Meeting) (at London School of Economics), at 9 30 A M —S W Rider and Capt T K. M Booth Discussion on School Geography —Miss A Hicks and others Discussion on The Beginnings of Geography —J A Mortlock, Miss J A Hardy, and others Discussion on The Teaching of Climate —Miss L C. Read, C C Carter, and others Discussion on Home Geography —Mr Cattell-Jones, Rev. J I Miller, and others · Discussion on School Geography Clubs and Journeys

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —F Balfour Browne Concerning the Habits of Insects (IV) The Habits of the Dragonfly

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C), at 3 —Dr W Martin. Gilbert White as Antiquary

MONDAY, JANUARY 5.

MATHEMATICAL ASSOCIATION (at London Day Training College), at 10 20 A M —Prof J E A Steggall: The Neglect of Arithmetic in Schools.—A Buxton An Application of the Bessel Functions to a Problem in Optical Resolution Discussion on Tangency and Limits in Geometry

EUGENICS EDUCATION SOCIETY (at University College), at 11 —National League of Health, Maternity, and Child Welfare —Dr. J A Hadfield Mental Health of the School Child

ROYAL DUBLIN SOCIETY, at 4 —Lecture adapted to a Juvenile Auditory

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4 30 —Brig -Gen Sir Wyndham Deedes Great Britain and the Palestine Mandate

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ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof G Dawes Hicks The Dynamic Aspect of Nature

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —W Irwin An Early Chapter in the Benzol Industry

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club), at 8 —A Healey, Mechanical Structure of Rubber

SCIENCE MASTERS' ASSOCIATION (Annual Meeting) (at University of Leeds), at 8 45.—Sir Berkeley Moynihan, Bart Presidential Address

TUESDAY, JANUARY 6

SCIENCE MASTERS' ASSOCIATION (Annual Meeting) (at University of Leeds), at 10 A M —Prof J H Priestly. Peat and the Plants that Grow upon it—A Yorkshire Problem —C B Fawcett The Distribution of Population —At 12, Prof R. Whiddington The Trend of Modern Physics —Prof R. W Whytlaw-Gray The Inert Gases —At 5 30, Prof W. Garstang The Songs of the Birds

MATHEMATICAL ASSOCIATION (at London Day Training College), at 2 30 —Prof G H Hardy What is Geometry? (Presidential Address) —Dr H. B Heywood The Reform of University Mathematics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —F Balfour Browne Concerning the Habits of Insects (V) The Habits of the Water-Beetle

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (at Manchester), at 5 30.—Dr J. E Myers and F. Fairbrother A Few Chemical Curiosities.

ASSOCIATION OF UNIVERSITY WOMEN TEACHERS (at University College) at 5 —Prof F Soddy The Economics of Life

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30

INSTITUTE OF MARINE ENGINEERS, at 6 30 —C H Wright Some Considerations in connexion with the Measurement of Liquid Fuel Storage and Liquid Depths

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at 17 Albert Square, Manchester), at 7

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7 —T H Gant. Cobalt Its Production and Some of its Uses.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Section) (at Broad gate Cafe, Coventry), at 7 15

WEST YORKSHIRE METALLURGICAL SOCIETY (at George Hotel, Huddersfield), at 7 30 —The Value of some Workshop and Laboratory Tests

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ROYAL SOCIETY OF ARTS (Dr. Mann Juvenile Lectures (I)), at 3 —Lt.-Col. G M Richardson Dogs in War

ROYAL DUBLIN SOCIETY, at 4 —Lecture adapted to a Juvenile Auditory

GEOLOGICAL SOCIETY OF LONDON, at 5

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6 —Prof E Mallett and A D Blumlein A New Method of High-Frequency Resistance Measurement

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Engineers' Club), at 7 —O Stott. Water Gauge

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JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7 30 —Dr A Russell Presidential Inaugural Address.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7 30

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LINNEAN SOCIETY OF LONDON, at 5.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —H W Taylor Three Wire Direct-Current Distribution Networks Some Comparisons in Cost and Operation.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub Centre) (at University College, Dundee), at 7 30 —F J Lawson Telephone Cable Practice

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre) (at Trinity College, Dublin), at 7 45.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynaecology Section), at 8 —J P Maxwell Osteomalacea in China

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INSTITUTION OF MECHANICAL ENGINEERS (Cardiff Branch) (at Cardiff).

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ROYAL SOCIETY OF ARTS (Indian Section), at 4 30

ROYAL ASTRONOMICAL SOCIETY, at 5

PHILOLOGICAL SOCIETY (at University College), at 5 30 —Miss Beatrice Saxon Snell Anglo French Building Terms.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St Mary's Parsonage, Manchester), at 7 —N Simpkin and F S. Sinnatt The Melting Point of Coal Ash Part 2.—Prof H S. Taylor The Properties of a Catalytic Surface

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INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —The Maintenance of High-Compression Oil Engines

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —A Keighley Colour and Sunshine Some Mountain Villages of Southern France.

INSTITUTE OF METALS (Sheffield Section) (at Sheffield University), at 7.30 —A H Mundey Die casting

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle upon-Tyne), at 7 30.—J L Taylor Theory of Longitudinal Bending of Ships

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch) (at Leeds) —H W Bannister The Scientific Treatment of Boiler Feed-Water.

INSTITUTION OF MECHANICAL ENGINEERS (Liverpool Branch) (at Liverpool).—L A Legros Traction across Rough and Roadless Country

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section).—R F Battey and J. Black Debate on Diesel Engines Four-Cycle v Two-Cycle

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SATURDAY, JANUARY 10, 1925.

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Science and Administration in East Africa.

THE members of the East African Parliamentary Commission, who returned to England on December 23, have not only a remarkable itinerary to record even in these days of rapid travel, but also, according to reports received from the five territories which formed the subject of their inquiries, a notable performance of work under peculiarly trying conditions. Moreover, their visit has been of special significance to scientific workers. Major Church, whose warm advocacy in Parliament of the claims of science to the greater support of the country and his exposition of the function of science in economic development led to his being charged with the responsibility of reporting on the scientific and medical services, and Mr. Ormsby-Gore, Chairman of the Commission and again Under-Secretary of State for the Colonies, have both given abundant proof in their public utterances of their appreciation of the scientific aspect of the problems of East Africa; their realisation of the imperative need for the augmentation of staffs of existing scientific departments; for the re-establishment of scientific institutions which have been either abolished or neglected, and for the provision of funds for a campaign against the greatest scourge in equatorial Africa, the tsetse fly.

To scientific workers in East Africa particularly, the visit of the Commissioners must have been a source of lively satisfaction, for they have been given little sympathy or encouragement in recent years. The appointment of the Economy Committee in Great Britain in 1922 for the purpose of reducing expenditure in public departments set an example to the colonial governments. But while the recommendations of Sir Eric Geddes for the crippling of our home research and technical services were tempered by the growing consciousness among all classes in England of the important part played by science in industrial development, those of his prototypes in East Africa met with no such opposition. Science departments were regarded generally as luxuries, and were either "axed" completely or made aware that their continuance for more than another year or two was contingent upon some tangible and material proof of their economic value. For example, the discovery of a rich gold reef by a geologist singly responsible for the geological work of a territory the size of Great Britain might be accepted as a justification for his continued existence. A suggestion by the victim that the discovery of minerals of economic importance was not his primary function, or that such discoveries could best be attained by a scientific and systematic examination of the geology of the country, would probably have been regarded, by the legal luminaries and administrative officers to whom was generally entrusted the task of reducing expenditure, as a confession of incompetence.

Although in the past year the ravages of disease among the human and animal population; the desiccation of certain hitherto fertile tracts of country due to unrestricted forest fires, the impoverishment of the soil and the increase of insect pests due to indiscriminate grass burning, the urgency of the need for local supplies

of fuel for transportation, industrial and domestic needs other than timber, the clamour of settlers and natives and merchants for the protection of economic crops against insect pests and diseases due to their partial realisation of the grave consequences attendant upon the neglect of precautionary measures, have had their effect upon the governments concerned, there remains yet considerable confusion of thought regarding the application of science to these matters The mentality still exists which would starve research in tropical diseases because there had been no recent calamitous outbreak, would contemplate with equanimity the expense entailed by the forced removal of a population of tens of thousands from an infected area when disease overtakes it, but once the immediate catastrophe was past, relapse into the old indifference to research

It is fortunate indeed that men like Mr Ormsby-Gore and Major Church were members of the Commission They made a special point of meeting every scientific officer available. In Northern Rhodesia the Commissioners met Dr May, who for many years has advocated heroic measures against the tsetse fly Dr Dixey, the Nyasaland geologist whose recent discovery of dinosaur remains has aroused considerable interest in Great Britain, and whose discovery of coal in the Chiromo district with indications of a coalfield of vast dimensions is of the utmost importance to East Africa, was able to show Major Church round the scenes of his labours and to indicate what was urgently required in the nature of a geological survey. In Tanganyika Territory, Dr. Shircore and Dr Butler discussed with him their divergent views regarding the relation of yaws and syphilis. Dr Scott was able to show the tremendous improvement that he has effected in the sanitation of Dar-es-Salaam, which promises to eradicate malaria in this district. The Commissioners travelled far through the fly belts with Mr. Swynnerton, whose heroic measures against the tsetse fly will establish his reputation as one of the foremost personalities in East Africa They visited also the Veterinary Research Laboratory at Mpapwa, where Mr Hornby is conducting a series of remarkable experiments to test the relative values of hyper-immunisation and immunisation In Uganda they met the important staff, consisting of Dr H L Duke, Dr G. D. H. Carpenter, and Mr Fiske, whose investigations into sleeping sickness must form the basis of any campaign for the removal of this human scourge. There also Mr Wayland and Mr Simmons, the geologists, gave them a greater insight into their purely scientific work and their discoveries of oil in the vicinity of Lake Albert Nyanza than the mere perusal of their official report would indicate; and in Kenya Colony they were able to judge dispassionately of the effect of decentralisation of the research laboratories which followed the departure of Mr V H Kirkman to Zanzibar The visit to the Amani Institute in Tanganyika a few days before departing from Mombasa convinced Mr. Ormsby-Gore and Major Church also of the urgent necessity of carrying on the work started by Zimmerman under the German Government

The Chairman of the Commission, in his public utterances, brought home to our East African communities the grave character of tsetse fly domination Many of his hearers learned for the first time that two-thirds of Tanganyika Territory is practically unfit for human or animal occupation through the activities of this insect and that in every territory visited the fly is increasing. He suggested that the malign influence of the tsetse fly upon tropical Africa is such as to merit the endowment by all civilised countries of a group of research workers to investigate the special problems connected with it

Major Church did well to remind his Mombasa audience of the disadvantages of parochialism, giving the decay of the Amani Institute as an illustration of his theme Although that great botanical research institute is ideally situated for carrying out work of vital importance to the whole of tropical Africa, intercolonial jealousies have led each colony to evade making a contribution to its upkeep, with the inevitable results He tentatively suggested also that the new bacteriological laboratories at Entebbe in Uganda might be supported by at least four of the East African territories owing to its advantages of situation In the same way, the Veterinary Research Laboratory at Nairobi in Kenya Colony, founded by Mr Eustace Montgomery, Veterinary Adviser to the Lake territories, might be considered as the principal veterinary research centre for East Africa, although the claims of the Mpapwa Laboratory in Tanganyika to this distinction must be considered Both Dr. Walker at Nairobi and Mr. Hornby at Mpapwa have much to gain by association under one roof On the other hand, the establishment of a research centre for investigations in connexion with tropical diseases other than sleeping sickness would be extremely costly, and in view of the present divergent lines of inquiry, and the sharp conflict of opinion regarding the nature of certain diseases, it is doubtful whether any advantage is to be gained at present by centralisation. But apart from any decision of the five territories to pool their resources to establish research centres catering for the needs of their populations, the need for co-ordination and co-operation between them is imperative.

Unfortunately, while it is admitted that the departments entrusted with human and animal pathological research are inadequately supported, in certain territories there is practically no provision for research of any kind Not even the important discoveries of Dixey of Nyasaland, or the work of Wayland and Simmons in Uganda, have sufficiently stirred the imaginations of the members of the legislative councils in the other three territories to stimulate them to create geological departments. Very little systematic research is being done in these same three territories in connexion with their economic crops, namely, cotton, maize, coffee, sisal, and wheat, while the possibilities of cinchona plantations have never been explored

It is hoped that this state of affairs will soon be remedied. Backed by the authority of the Commissioners, there should no longer be any excuse for timidity on the part of colonial governors, most of whom personally are fully alive to the necessity for scientific research, and it is sincerely hoped that they will without delay put bold estimates for its prosecution before the members of their respective Legislative or Executive Councils.

Roman Britain.

(1) *The Roman Occupation of Britain: being Six Ford Lectures delivered by F. Haverfield, now revised by George Macdonald, with a Notice of Haverfield's Life and a List of his Writings* Pp 304 + 9 plates (Oxford. Clarendon Press; London: Oxford University Press, 1924.) 18*s* net

(2) *Roman York: the Legionary Headquarters and Colonia of Eboracum.* By Gordon Home Pp 204 + 30 plates (London Ernest Benn, Ltd., 1924) 12*s*. 6*d* net

THE Ford lectures of the late Prof Haverfield were delivered at Oxford in 1907 At the time of their delivery it could be said by the man best qualified to judge, "that the enquiry into the history and character of Roman Britain, with all its defects and imperfectations, has been carried much farther than the enquiry into Celtic or Saxon Britain, much farther, too, than the enquiry into any other Roman province, and that our scientific knowledge of the island, however liable to future correction and addition, stands by itself among the studies of the Roman Empire" It was, in fact, high time for such a summary of results and retrospect of the course of inquiry as might be expected from a Ford Lecturer.

(1) Haverfield was not, however, the man to publish immature work. To those who were privileged to hear them, even if they had worked with him and for him—and he had more truly founded a school than any of his contemporaries at Oxford—the lectures of 1907 were a revelation Yet publication was postponed, the multifarious calls upon the time of a man as efficient and thorough in university business as he was in the direction of research, then the War, the separation of a man capable of great friendships from continental colleagues, the loss of so many of those younger men whom he had trained and inspired; the more urgent need, as it might well seem, to press on with current work and raise a new generation of workers—all this intervened, and the lectures appear now as a memorial volume, at once of their distinguished author and of the three hundredth anniversary of the Camden chair of ancient history, which he filled with such vigour and distinction

The necessary revision of the drafts, and expansion on the lines projected by Haverfield himself, has been admirably done by Dr George Macdonald He has also supplied an intimate study of the man and his life's work, and a bibliography which, though limited to signed articles, and exclusive of book reviews, fills no less than eighteen printed pages, and runs to as many as twenty-five items within a year

The study of Roman Britain is an instructive example of the ups and downs of scientific method Quite early in the Saxon period, the standing monuments of Roman occupation, and the folk-memories of the surviving British, challenged attention and comment, and on the British side of the breach, there were traditions older still, of the coming of the Romans, and of Celtic resistance to them There has never, therefore, been a time when the written history of our island did not begin with a retrospect of "Roman Britain" In the twelfth and thirteenth century renaissance, which gave us the University of Oxford, it was the same, with the new habit added, of describing the monuments, deciphering inscriptions—more generally practicable then than now, for a generation whose learned language was still Latin—and attempting to identify places and lines of communication

The achievements, in this direction, of men like Henry of Huntingdon and Geoffrey of Monmouth, have been the sport and the despair of their successors, and their ghosts still haunt the local antiquary Even quainter disservice was done by renaissance scholarship abroad, whereby, in great ignorance of topography or philology, "obsolete names of cities are set forth in modern fashion," as in Servetus's edition of Ptolemy But the "Britannia" of William Camden was recognised, at its first publication in 1586, as opening a new era of research It stands, indeed, by the side of the classics of natural philosophy as a pioneer of the "advancement of learning" Camden, however, though a great antiquary, was not a first-class scholar, nor of scrupulous accuracy or self-criticism among the temptations which beset all historians, and some of his fertility of imagination and slovenliness in detail has descended upon lesser men, along with his inspiration to systematic field-work Other handicaps were, the disfavour into which the Society of Antiquaries fell under James I; the divorce between this London institution, after its revival in Stukeley's time (1717–18), and the literary scholars of the Universities, and Stukeley's disastrous acceptance of the forged "Richard of Cirencester," which perverted almost everything that was written on Roman Britain for a full century after 1757

It was only gradually that the Roman occupation of Britain came to be conceived either as a well-marked and peculiarly self-contained phase of British history, or as the local aspect of Roman imperialism. The antiquarianism of the eighteenth century was the hobby of a few able amateurs Camden's classification of antiquities by counties stimulated much county-history and local patriotism of a competitive kind, but few attempts to comprehend either whole periods or natural regions Then, the new movement in scientific thought which escorted revolutionary politics,

and the æsthetics of romance, found one of its characteristic expressions in a philosophy of history, and another in the regional studies appropriate to an age of nationalism. While Niebuhr, Ranke, and Mommsen were making history scientific, the squirearchy and the "literary and philosophical" societies made archæology popular and fashionable The "new rich" of the early nineteenth century, as of the seventeenth and the twentieth, followed the fashion, became collectors and sometimes connoisseurs; and the "classical" education administered, for similar reasons, to their sons perpetuated an acquaintance with Cæsar's work, at all events, as part of the outfit of a gentleman, though at some risk to his knowledge of either history or geography

Probably there are few countries even now in which an interest in "Roman remains" lies so near the threshold of consciousness as in Great Britain, few, however, in which the notion of them as a subject of scientific investigation was, until recently, so remote even from the minds of many scholars

The last generation of explorers, indeed, has had almost as much to undo as to create. The ancient divorce between university scholarship and regional field-work, which was notorious in Camden's time, persisted within living memory; and in so far as they have been reconciled, it has been the work of two men, Haverfield himself and Pelham, his predecessor in the Camden chair. The characteristic English disbelief in anything systematic or expert, whether in training or in research, is hard to defeat: the distance between London and the older Universities hampers intercourse between literary scholars and the national storehouse of antiquities, the "little learning" of the local antiquary, and his invincible antipathy no less to the use of modern languages than to continental methods of study, have stultified the benevolence of local patrons, which has often been generous.

For this state of things there are two remedies, illustrated respectively by the two books under review: better scholarship and wider background of knowledge on the part of the local field-worker—and a book like that of Mr. Home on Roman York would have been impossible twenty years ago—and closer and more persistent supervision and correlation of the field-worker by what may justly be described as a head-quarters staff For, as Haverfield frankly concludes, in his first Ford lecture, the reforms effected by Mommsen in particular in Roman history during the nineteenth century "make it doubtful if the amateur can in the future do any real good." "The whole subject has become much harder", for "to-day, unfortunately, accuracy is necessary"; and if we seem not to know now a good many things which passed current with antiquaries half a century ago, it is due to ruthless critical revision by a few men of scientific training and experience

This critical revision of our knowledge of Roman Britain has various opportunities and lines of approach, as the lectures in question demonstrate The older historical geography dealt with political boundaries "described pictorially on a series of vari-coloured sheets": it is quickly giving place to a "wider and a wiser view" of the relations of geography and history, which "begins by studying the physical features of the world by themselves," and only afterwards attempts, in the light of this knowledge, "to deduce the influence of these physical features in any special period" Only so, as in the first lecture of this series, can the strategy, for example, of Claudius's campaign of conquest in A D 43 be appreciated, and the later operations of Agricola, Hadrian, or Ulpius Marcellus, and the revolt of Boadicea, or of the North in the days of Commodus, be set in their true perspective Only so, too, in the light of continental work on the defences of other frontiers of the Empire, on the Rhine or the Danube, and in North Africa, can the details of legionary camps and outposts of "auxiliary" troops be seen as parts of an orderly scheme of occupation, and as Mommsen himself admitted, "you have such wonderful inscriptions in your North country; no land tells us more about the Roman army."

Similarly, the "Romanisation" of Britain is a special and exceptionally interesting example of a process which was going on, during the same four centuries, in many border-lands. Here again geographical conditions impose rather austere control, all higher culture being "confined to a definite area in the centre, the east, and the south of the province. . . . Outside that area we may search practically in vain for traces of civilised life. Inside it we shall find almost nothing else," for when the military situation was once defined, troops were not stationed where they would be out of action in case of trouble on the border. There are qualifications to be made, of course; "in particular, the midlands were thinly and poorly peopled," yet in Cambridgeshire, as Dr. Cyril Fox has shown more recently, it was during the Roman occupation that we can first trace any serious exploitation of the forest-ridden clay-lands. There is a practical moral to this midland emptiness: "amidst its great woodlands, and on its damp and chilly soil, agriculture can expand only under the exceptional conditions of a Napoleonic war. Pigs, sheep and cattle may flourish better. . . ." So history repeats itself, and Roman Britain in its broad geographical features was very much the Britain that we know.

More important was the life of the towns; and though the first novelty of Haverfield's pioneer essay on

"Ancient Town-planning" is necessarily lacking here, the sections on the origin, structure, and outlay of Roman British settlements, the adaptation of Roman architectural conventions to British weather and Celtic habits, and the pottery and other characteristic elements in the furniture of the houses so developed, receive much fresh illustration and commentary, and no less perpetual challenge to traditional misconceptions, whether the true story be available as yet or not.

Especially is this suspension of judgment, out of very fullness of knowledge, apparent in the last of these lectures, entitled "Roman Britain and Saxon England," and dealing with a state of things of which the writer frankly says that "if for one reason it is not to be called a period, for another reason it can hardly be called history Like the Bronze Age or the Early Iron Age, it lies outside the ordinary range of historians . . . The early history of the English has been written often enough. But it is mostly fiction. . . The Celtic world is equally unhelpful; . . I do not think I have exaggerated the general uncertainty which overhangs large parts of Celtic studies Here assuredly is no place for a respectable historian" In Roman Britain, on the other hand, even for so severe a sceptic, "ancient history comes to the rescue of modern" · archæological detail purging the rhetoric and errors of Gildas But "legend is history personified in fiction When we can test legends, the general history . . proves usually to be true. . . The heroic age remains—without the heroes" "The struggle between Roman British culture and Saxon barbarism was on a small scale, truly, compared with the great continental movements of that age; but it was evenly balanced and fiercely disputed"

Here archæology confirms legend utterly. "The conquerors were destroyers" "No case is known where Saxons dwelt in a Roman villa"; either by sack and burning, or by evacuation, the Roman towns ceased to exist as settlements as completely as those of the Danubian frontier of Noricum. Geographical criticism comes to the rescue here too. The Saxons' advance "went on to the same point as did Rome's," and coots laid their eggs in the baths of Aquæ Sulis. "Like Rome's, it came to a stand at the foot of the hills" in more violent conflict with the Saxon Chronicle than with the surviving Britons But "for the rest, the Roman has passed from Britain as though he had never been" Once more, however, this is the regional and, therewith, ephemeral view. "Had Rome failed to civilise, had the civilised life found no period in which to grow firm and tenacious, civilisation would have perished utterly" But geographically Britain is an over-straits counterpart of what then was Gaul; while Britain became England, Gaul became France; and in the longer story of the Romanisation of the Frank, and through him of Saxon and Angle over-straits, we have the link which makes the history of Roman Britain a chapter consecutive with our own

(2) That a book like Mr Home's "Roman York" should find a public or a publisher at all, is testimony to the real and wide interest in Roman studies, to which allusion has already been made. When we consider, as the author notes in his preface, that the total number of original references to York in extant Latin literature is five, and that the remainder of its history must be reconstructed, like a mosaic, from "indirect references and inferences" in the light of epigraphic and archæological evidence, we realise the amount of laborious compilation which goes to a book of more than two hundred pages It is indeed, at the same time, rather more than a history of Roman York, and a good deal less than a survey of Roman Britain, but the preface disarms criticism of its discursiveness, and indeed Mr Home has only applied to a particular site the method of illustration from other places and districts which gives their value to the Ford lectures.

Mr Home, however, is evidently not a trained scholar, his Greek, and occasionally even his Latin, needs revision, his references are few, usually without "chapter and verse", in a note on p 59, all three titles refer to the same document! His English equivalents for Roman official titles are not always happily chosen; his account of the status of *municipium* and *colonia* is obscure, and he refers on p. 76 to "Huns" in connexion with the events of A D 284 But he evidently knows York and its neighbourhood intimately; he has had the valuable help of Dr. Collinge, Mr. Foord, and other local colleagues; he writes vigorously and easily, with a certain touch of imagination which gives coherence to a needlessly large mass of detailed information, and he has illustrated his book with a number of excellent photographs He does not often mention Haverfield's work, and occasionally falls foul of his opinions; but, knowingly or not, he has learned in his school, and his essay is living testimony to that revolution in method of which the Ford lectures are an epitome.

Astrophysics without Mathematics.

Modern Astrophysics By Prof Herbert Dingle Pp. xxviii+420+46 plates (London and Glasgow: W Collins, Sons and Co, Ltd, 1924) 30*s*. net.

THE science of astrophysics has long since attained its majority. It no longer needs the protecting presence of some more ancient science. But it is at present almost devoid (at least in the English language) of that ordinary possession of a science—a literature. It needs its classics, its authoritative treatises, its workaday text-books, its popular expositions; its

works of compilation and its works of criticism, its manuals of theory and its manuals of practice

Prof Dingle's "Modern Astrophysics" is a pioneer attempt at a popular exposition of the subject As stated in the preface, the book is intended for the general public, and the popular appeal has been given first place. It is also comprehensive Its aim is to put a reader without specialised knowledge—either of physics, astronomy, or mathematics—in possession of the main range of facts of observation and of the theories propounded to explain them.

It may be said at once that not only is there no book in English which even attempts this, but also that Prof Dingle's book does, in some measure, achieve its aim. The demands on the non-technical reader are probably greater than the author supposes, but he who is prepared to face four hundred pages of somewhat amorphous prose is conducted twice round the whole existing observational material, is taken to some of the bounds of existing knowledge, and is invited to peer into the recesses of the unknown The author conscientiously faces what he considers to be difficulties, and the book abounds in independent criticism, though not all of it is wise The popular reader will, however, feel that the greatest respect has been paid to his intelligence and that he has been brought to the point at which he can at least frame sensible speculations of his own.

In collecting and arranging the facts, Prof. Dingle has expended a great deal of labour—labour which will make easier the future tasks of others. For he has at least got the subject into a whole, though rather a shapeless one. In this connexion it may be regretted that references are almost non-existent. If these had been given even only for the tables, the professional reader would have been greatly helped and the non-professional one would not have been unduly terrified

The book would have been improved if the frequent dramatic and rhetorical passages had been omitted, for they do not succeed in stimulating the reader's emotions more than would simple narration The author says that lack of space has compelled him to be brief This shows want of self-criticism. The book suffers from diffuseness. Repeatedly, loss of clarity arises from excess of explanation Though possessing the literary form of a popular work, it has the dimensions and price of a treatise, and if it had been reduced by one-third and better provided with sub-headings, it would have been more readable and nothing of value need have been omitted.

When one of the objects of the book is to give non-mathematical explanations, it is disappointing to find how often opportunities have been missed It is possible to show very simply, in words, how the angular diameter of a star is connected with its surface brightness, how observations of eclipsing binaries yield determinations of stellar densities, and how the detection of a moving cluster plus a single determination of radial velocity affords good determinations of parallax. These are three simple, fundamental relationships Yet, in Prof. Dingle's text, the first is confused with the irrelevant introduction of parallaxes and the linear diameters of stars, the second is stated but not argued out at all, and the third is omitted save for a reference to the fact that if the parallax of one star of a moving cluster can be found, those of the remainder follow from the common velocity Similarly, no attempt is made to show why the period of a Cepheid should be expected to decrease with increasing density.

This is the more to be regretted in that occasionally the author conveys much in little in an illuminating epigram, for example, when he remarks that though novæ have been classed as variable stars, "it is doubtful if such a classification expresses anything more than the philosophical instinct which craves after generalisation"; or again, referring to the maintenance of energy, "evidently one of the star's most important functions, the expression of its instinct for self-preservation" And such a sentence as "A variable star is not the opposite of a fixed star" is a charming example of tenderness for the difficulties of non-professional brethren.

Serious criticism can be made of the actual substance of parts of the book; for example, the chapter on the sun contains a long description of the "rival theories" of the gaseous photosphere and the cloudy photosphere, and the author gives the impression, and evidently himself believes, that there is little to choose between them Surely this is to speak the language of a previous decade It may be regarded as completely certain, and is believed on reasoned grounds by the overwhelming majority of astrophysicists, that the photosphere does not consist of opaque incandescent clouds. The author largely ignores the accepted results of mathematical investigations, whilst attempting to traverse the same ground verbally; for example, the difficulty that has usually been encountered as soon as we leave the primrose path of verbal argument and introduce a few numerical estimates of orders of magnitude is that the sun's boundary ought to be more sharp than it is, not less sharp.

Again, in dealing with the interior of a star, the author shows how radiation is handed on from layer to layer, and gives an indication of how the effect has been calculated by Eddington. But in dealing with the sun he remarks "how the energy distribution would be related to the huge range of temperature from the sun's centre to its surface is indeed a difficult problem It may be doubted whether the relation

would have much analogy with that observed when an isothermal surface is the radiator" This is not the only failure on the part of the author to assimilate different researches Though there is an introductory section on the theory of spectra, much of the book is written in the language of the era before a theory of spectra existed It would surely be easier for the ordinary reader to understand resonance radiation and fluorescent radiation rather than to be mystified by "non-temperature" radiation. Referring to Wolf-Rayet stars, Prof Dingle says: "The Wolf-Rayet stars seem to be the only ones that behave as a wholly gaseous mass should Their spectra are intelligible—a faint continuous spectrum due to the light from the high-pressure interior which has managed to escape, with a bright-line spectrum from the surface layers impressed on it" Prof Dingle is entitled to state his intuitive expectations, but he is not entitled to ignore the fact that mathematical analysis shows that a star is to be expected to give an *absorption* spectrum, the difficulty is to explain the existence of bright lines. On another page, however, he remarks that "Wolf-Rayet radiation in general is inexplicable" His attempted explanation of a bright-line spectrum—that when a star reaches its maximum temperature its central parts are cooling whilst the outer ones are getting hotter—is inadmissible, as a simple calculation shows

The author suggests that the hypothesis of the synthesis of helium from hydrogen is in keeping with the observed fact that the second spectrum of a nova has weaker hydrogen lines and stronger helium lines He apparently fails to realise the exceedingly small mass of gas required to produce even intense lines, an amount utterly negligible compared with the amount either of hydrogen or helium probably available

Prof Dingle says that, as we do not know the precise conditions inside a cooled star, we are at liberty to make any assumption that is not inconsistent with the little we do know He then says that diffuse nebulæ may arise from a catastrophic outburst in a cooled star, for "we cannot say this is impossible so long as the heat energy inside the star is sufficient to account for the gravitational potential energy of the nebula, and there is every reason to believe it is sufficient" But why this meticulous respect for the first law of thermodynamics when the second law is being thrown overboard? It is simply not fair to the non-technical reader to make unorthodox suggestions of this kind without fully pointing out the nature of their unorthodoxy.

The looseness shown by these examples is unfortunately present in much of the reasoning Astrophysicists will use the book for its summaries of facts, but they will be little helped by its theoretical discussions

E. A. M.

Blood Pressure in Early Life.

Department of Applied Statistics University of London, University College Drapers' Company Research Memoirs. Studies in National Deterioration, XI Blood Pressure in Early Life: a Statistical Study By Dr Percy Stocks, assisted by M Noel Karn Pp iii+88 (London Cambridge University Press, 1924) 12*s* net

DR PERCY STOCKS' work entitled "Blood Pressure in Early Life" immediately strikes one as filling a long-experienced gap in medical literature Systolic and diastolic blood pressures are, indeed, taken to-day almost as a routine in the medical examination of a patient, and yet it is notorious how hazy are the conceptions of the normal range of these at different ages Especially is this the case in childhood and adolescence The principal aims of the author, therefore, were to investigate the behaviour of blood pressure during the period of puberty and adolescence, to ascertain the normal range of systolic, diastolic, and pulse pressures at ages from 5 to 40, and to examine the interrelation between these pressures and their correlation with pulse rate, physical development, muscular strength, respiratory and psychological factors, social-class and athletic habits of life

The study, which is a statistical one, has brought out some extraordinarily interesting results, a few only of which we shall be able to mention. The systolic pressure is found to rise as a simple function of age from 5 to 11 years The onset of puberty causes a well-marked accentuation in the gradient until at the age of 19 a maximum of 130 mm of mercury is reached From 19 to 40 years of age no further change is detectable The comparatively rapid rise in systolic blood pressure during puberty is shown to occur even when the figures are corrected for body weight, which itself is positively correlated with blood pressure The diastolic pressure, on the other hand, shows an interesting divergence from the course of the systolic pressure in its rate of rise with age In this case puberty at first hinders the rise, but this delay is followed at the age of 18 by a rapid rise to a maximum during the 21st year Following this the diastolic pressure tends to fall somewhat up to the 37th year

It is evident from the age curves of systolic and diastolic pressures that the pulse pressure increases rapidly at the onset of puberty to reach a maximum about the age of 18, after which it decreases equally rapidly into the 21st year, afterwards increasing again as a simple function of age.

These are some of the facts elicited by this statistical study Their explanation is, however, difficult Dr

Stocks incriminates the endocrine glands in the causation of the rapid rise in systolic pressure during adolescence Experimental evidence, however, is against any pressor action by the sexual hormones, although the possibility of the suprarenal and pituitary bodies being in part or in whole responsible for this change cannot be excluded

The product of pulse pressure and pulse rate is found to show a well-defined maximum during adolescence, the curve representing this product plotted against age showing a superficial resemblance to that of rate of growth in body weight The author tentatively agrees to the contention that this product is "an index of cardiac energy expended per minute in maintaining the circulation," and even gives this contention the dignity of an algebraic notation. We would point out that the static factor in the total energy expenditure of the heart per minute is proportional to the product of the minute output and the mean blood pressure during the ejection phase of cardiac systole, and is in no direct manner connected with the pulse pressure Indeed, the fallacy of Erlanger and Hooker's suggestion was conclusively demonstrated by Miss Skelton, who found that the relation between the pulse-pressure pulse-rate product and cardiac output in the isolated mammalian heart varied enormously, in one experiment between 7 to 1 and 47 to 1

Again, in adults, assuming that the average output per beat remains fairly constant up to middle life, and assuming that the pulse-pressure pulse-rate product is an index of the energy expended by the heart per minute, the author draws the conclusion that the mean product of pulse rate and pulse pressure is directly proportional to the mean work done by the heart per minute, which is merely one of the author's original assumptions Figures calculated on the further assumption, that the mean output per beat in large groups of growing individuals is proportional to the mean body weight of these groups, show that if the assumptions are justified one "must conclude that, when the age of 16 has been reached, the average heart is performing as much as or more gross work per minute than in adult life, in spite of the fact that it has presumably not attained full size."

Thus many of the conclusions of the author are based on the assumption that the pulse-pressure pulse-rate product is an index of the work done by the heart We repeat that the experimental evidence strongly militates against the validity of this assumption. This, of course, merely throws doubt on the interpretation of Dr. Stocks' statistical figures The results obtained are of absorbing interest and undoubtedly will be of great value to medical officers of schools and of insurance companies

Our Bookshelf.

The Physiology of Photosynthesis. By Sir Jagadis Chunder Bose Pp. xx+287 (London: Longmans, Green and Co, 1924) 16s net

LIKE all the monographs from the Bose Research Institute, this book contains an account of new and very ingenious experimental methods, and a discussion of experimental results, so detached from the general current of plant physiological literature that it becomes difficult, if not impossible, to assimilate the new data into the fabric of the science. Practically all experimental work is carried out upon the water plant *Hydrilla verticillata*, a most ingenious bubbling method being used to record the rate at which oxygen is released during photosynthesis.

The presence of nitrogen in the gas expelled from the plant is prevented by supplying the plant with water free from nitrogen, but where experiments are being carried out in varying concentration of carbon dioxide, the earlier work of Devaux on the intercellular atmosphere of water plants suggests caution in the interpretation of experimental data This method, however, rendered automatic by an electromagnetic device registering on a recording drum, should prove of very great value and have many applications

Two other methods are also used; in one the rate of oxygen discharge is recorded by the change of buoyancy in a submerged shoot attached to a torsion balance; in the other the bubbles are removed by raising the shoot out of water and then measuring afterwards, either in a torsion balance or a precision chemical balance, the change in *density* of the submerged shoot due to the accumulation of assimilates which are assumed to be carbohydrates Osmotic and turgor changes with their consequent effects upon the volume of the intercellular air system are apparently disregarded in this method

As to experimental results, Prof Bose has previously briefly reported in NATURE (July 21, 1923) the great sensitiveness of the process of photosynthesis to certain substances, as, for example, to the slight amount of nitric acid carried down into the ponds after thunderstorms Many of his more general conclusions will probably not attract so much attention as the new experimental methods he has employed

The Cultivation of New Zealand Plants By Dr L Cockayne (New Zealand Practical Handbooks.) Pp 139+21 plates (Auckland, Christchurch, Dunedin, Wellington, Melbourne, and London: Whitcombe and Tombs, Ltd., n d.) 4s. 6d

DR COCKAYNE deserves the thanks of those interested in horticulture, both in New Zealand and in the British Isles, for his excellent practical book on New Zealand plants It is of particular value for plant lovers in New Zealand, since he brings to their notice the many remarkable native plants which gardeners are so apt to neglect. It is too often the case abroad to find that residents, who may have come from the Home Country, desire only to grow those plants they have known at home, and often neglect almost entirely the native plants of their country of adoption Similarly, in Botanic Gardens in the Colonies, it is common to find the native flora very largely neglected and mainly a

fine collection of exotic plants under cultivation From Dr Cockayne's book it is clear that in the New Zealand Botanic Gardens, care is taken to cultivate as representative a collection of the native plants as may be possible, and the efforts which have been made in this direction are worthy of the highest praise

Now, thanks to Dr. Cockayne, the same aim is made possible and easy to all lovers of gardens in New Zealand, as he gives full particulars as to how the plants should be procured and cultivated, and then goes on to give lists with good descriptive accounts and methods of propagation of the native trees, shrubs, Veronicas, herbs, climbing plants, and ferns suitable for gardens There is also an interesting and very useful chapter on native plants suitable for town gardening The book is well illustrated with a number of excellent plates, and is also furnished with a map and full index

Das Wildseemoor bei Kaltenbronn im Schwarzwald ein Naturschutzgebiet Von Dr Karl Muller Pp vi + 161 + 19 Tafeln (Karlsruhe i B G Braun G m b H, 1924) 3 marks

THE author spent thirteen years in the study of a particular piece of moorland vegetation in the vicinity of Baden-Baden The area is noted for its beauty and Dr Muller loves the region—a fact that contributes largely to the fascination of the book But not only is the Wildsee a lovely spot, it is also of peculiar interest to the student of natural history In his preface the author states that "the fauna and flora of the moor is that of the arctic-alpine type comparable to an island in the midst of a sea of central European forest produced by the ecological singularity of its position" Beginning with the history of the moor from the eighteenth century, he traces its life from 1780 when its water supply was originally tapped Later, the peat itself was exploited During these periods the drained areas were utilised for afforestation schemes with conspicuous failure—sphagnum growing most freely on those areas from which the peat had been taken and reconverting them into bogs Since the Armistice, the author's knowledge of the region and his numerous articles upon it have assisted in the postponement of further projects to use the peat, and we are glad to learn that this beauty spot will be converted into a national preserve. The book is well illustrated with photographs and maps, but unfortunately it does not possess an index, though it has a good table of contents It will appeal to all lovers of Nature and to students of ecology, for it contains much useful material attractively arranged regarding moorland vegetation It was written originally to interest all who know and love this beautiful part of the Black Forest

Lectures on the History of Physiology during the Sixteenth, Seventeenth and Eighteenth Centuries By Sir Michael Foster Second impression Pp vii + 306 (Cambridge: At the University Press, 1924) 15s net

THE history of the development of medicine has been told many times, but rarely can we gather from these accounts a clear history of the two subjects, anatomy and physiology, on which the whole structure of the art of healing is built The late Sir Michael Foster's book consists of the "Lane Lectures" delivered at the Cooper Medical College in San Francisco in the year 1900, and gives a detailed narrative of the progress of physiology in the sixteenth, seventeenth, and eighteenth centuries In one important detail it differs from many books of its type, it is the history of the science, not merely of the lives of scientific workers Yet there is included much about the personal histories of the pioneers of physiology which stimulates additional interest in the fruits of their labours. The author sees in the efforts of Vesalius against the blind dogma of the Middle Ages the foundations of modern physiology and modern anatomy, Harvey's great work he regards as the direct outcome of those efforts. The influence of advancing knowledge of physics and chemistry is demonstrated in the ideas of Borelli, Paracelsus, and Franciscus Sylvius In Mayow's realisation of the functions of what is now called oxygen there is an illustration of how a great scientific discovery may be completely ignored in its time and find recognition after more than a century

The value of this book may be indicated by quoting the author's own words. "It is one of the lessons of the history of science that each age steps on the shoulders of the ages which have gone before" The student will find in the book an account of this progression which will enable him better to understand the physiology of his own age

Antiques their Restoration and Preservation By A. Lucas Pp. viii + 136. (London: E Arnold and Co, 1924) 6s net

MR LUCAS's book forms a very useful introduction to the modern methods of treatment of antiques, on which subject very little literature has hitherto been available, but, being written in as non-technical a manner as possible, it is likely to be of more value to the antiquarian than to the chemist.

The work is divided into four chapters, the first two giving a general outline of methods of treatment, while the third is devoted to their application to specific materials A short final chapter gives certain simple tests for determining the composition of objects.

While the majority of the methods recommended in the third chapter have been found to be safe, yet certain of the author's methods would be dangerous in inexperienced hands For example, the treatment of papyrus by soaking in water is somewhat drastic. Papyrus, which is composed of small sheets stuck together, is very liable to disintegrate under treatment, and it is safer to cover it with moist blotting-paper. But in most cases the author has confined himself to describing methods of proved utility, which, provided the fragility of antique objects is borne in mind, can be used by any one. He is, however, rather unduly fond of the use of paraffin wax, to which cellulose acetate is usually to be preferred

Some of the tests given in the fourth chapter may be misleading to those ignorant of science The methods given for determining specific gravity are likely to be very inaccurate Since the object must in any case be weighed in air, it would be better to instruct the reader how to weigh it in water, for only thus can an opinion be formed as to the genuineness of, for example, a coin But these are comparatively small faults in a book which all antiquarians will be well advised to study R A M

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications*]

On the Luminescence of Solid Nitrogen and Argon.

A LETTER in NATURE of November 15, by Prof L Vegard, contained some statements regarding the work of Dr Shrum and myself on the luminescence of solid nitrogen and argon that would appear to warrant some comment from me Prof Vegard's article appears to give the impression that our discovery that the band near $\lambda = 5577$ Å in the spectrum obtained with solid nitrogen had a triplet structure with none of the components coinciding with $\lambda = 5577\ 35$ Å was made after he himself had noted this fact A reference to our paper will show that it was received by the Royal Society on June 14 of this year A brief notice of it appeared in NATURE of July 5

Although we had found late in January 1924, or early in February, that this band, now called N_1 by Prof Vegard, had a triplet structure, we withheld publication of that fact until a paper by Prof Vegard should appear, because we inferred from reports appearing in the daily press about that time that he had found the auroral "green line" in the spectrum of solid nitrogen bombarded by electrons

As no reference to the triplet structure of the N_1 band was made in Prof Vegard's paper that appeared in *Comptes rendus* of March 31, or in that published in the issue of NATURE for May 17, we communicated our paper to the Royal Society on June 14 On June 17 Prof Keesom communicated to the International Congress on Refrigeration a paper by Prof Vegard summarising the latter's work, and dated May 13, with an appendix dated May 31, and a further one dated June 13 In this paper, and in its appendices, again no reference was made by Prof Vegard to the structural character of the N_1 band

At the conclusion of the presentation of Prof Vegard's paper at the Congress of Refrigeration, I was permitted to show our photographs of the solid nitrogen spectrum in which the structure of the N_1 band was revealed. In a paper in *Comptes rendus* of July 7, Prof Vegard referred for the first time to the fact that the N_1 band had a triplet structure This paper, therefore, confirmed our results, although no mention was made in it of our work, which was known to Prof Keesom and others from the Leyden laboratory, on June 17 Again, in a later paper in *Comptes rendus*, July 21, Prof. Vegard dealt with the subject, but again made no reference to our work It is not conceivable that Prof Vegard observed prior to June 13 that the N_1 band had a triplet structure with none of the components coinciding with the auroral green line, and withheld that very important fact in the communications of his results obtained up to June 13

Prof Vegard suggests that differences between his observations and ours "may be partly due to the fact that their [McLennan and Shrum's] experimental material was very limited, and that their arrangements made it difficult to overlook the experimental conditions and to vary them in a known way." Prof Vegard apparently is not familiar with the equipment available in the Physical Laboratory at Toronto for researches of this character Many scientific workers who have visited our laboratory will be able to support me in the statement that our cryogenic and spectroscopic equipment is amply sufficient to meet far more exacting demands than those presented in this investigation A casual glance at the reproductions of our photographs will show, too, that we were not ignorant of the best methods of using this equipment Again, Prof Vegard states that our difference of opinion does not originate from a difference with regard to experimental facts If we, with our experimental arrangements, were able to obtain the same experimental facts as he did, then he can scarcely maintain that our experimental arrangements made it difficult to "overlook and vary the experimental conditions"

The experimental facts in so far as we know them are as follows

We found that when solid nitrogen was bombarded with electrons, the luminescent band N_1 consisted of three "broad lines or narrow bands," with mean wave-lengths $\lambda = 5654$ Å, $\lambda = 5617$ Å, $\lambda = 5556$ Å Prof Vegard has found the same structure, but with the mean wave-lengths $\lambda = 5640$ Å, $\lambda = 5611$ Å, and $\lambda = 5555$ Å

We found that solid nitrogen, when made to phosphoresce by electronic bombardment, gave a spectrum consisting in the visible region of a single broad line or narrow band at $\lambda = 5231$ Å Prof Vegard finds the wave-length of this narrow band to be $\lambda = 5229\ 4$ Å

We found that the spectrum of pure solid argon, when the latter was bombarded by electrons, contained a band consisting of two components, one of them being strong with a mean wave-length at $\lambda = 5607$ Å, the other faint with a mean wave-length at $\lambda = 5648\ 3$ Å

Prof Vegard, when bombarding solid argon containing varying amounts of solid nitrogen with electrons, found a spectral band consisting of several components with the strongest member having a mean wave-length at $\lambda = 5604$ Å

We found, when great precautions were taken to purify the argon we used, and only when such precautions were taken, that solid argon phosphoresced after bombardment by electrons, and that the phosphorescence spectrum of argon so treated consisted in the visible region of two broad lines or narrow bands at $\lambda = 4750$ Å and $\lambda = 5300$ Å. This phosphorescence spectrum of solid argon Prof Vegard does not appear to have observed as yet

Prof Vegard takes the view that the results of his solid nitrogen-argon experiments indicated the oscillation of the principal maximum in the N_1 band between $\lambda = 5555$ Å and $\lambda = 5604$ Å.

We feel inclined, however, to the opinion that his results in this connexion indicate that he obtained a mixture of the N_1 components of the nitrogen band and of those of the argon luminescence band in the same region It may be added that, in our experiments, we found the positions of the components of the N_1 nitrogen band, as well as that of the N_2 phosphorescence band, the same with the solid nitrogen at the temperature of liquid helium as at the temperature of liquid hydrogen

Our experiments, it may also be stated, did not preclude the possibility of the components of the N_1 nitrogen band originating in the cold vapour of nitrogen in contact with the solid nitrogen Prof Vegard is of the opinion that these component spectral bands originated in the solid nitrogen only. He concludes that if the particles of the bombarded solid nitrogen were gradually reduced to molecular dimensions, the N_1 composite band would degenerate finally into the very fine auroral line $\lambda = 5577{\cdot}35$ Å It is difficult for me to follow him to this conclusion

It seems to me that in an examination of the

validity of Prof Vegard's theory, some useful information might be gained by directing more attention to the *phosphorescence* of solid nitrogen Does the phosphorescent nitrogen band $\lambda = 5231$ Å appear in the spectrum of the aurora or not ? If it can be shown that it does, we shall know that the region in which the auroral light originates is at or near the temperature of liquid hydrogen If this line does not appear in the spectrum of the aurora, and if the temperature of the region in which the radiation constituting auroral spectra originates is at or near the temperature of liquid hydrogen, then why does the phosphorescence nitrogen spectral band not appear along with other nitrogen bands found in auroral spectra by Vegard, Rayleigh, and others

From Kayser's "Handbuch" one finds that a line or narrow band has been found by different observers in the spectrum of the aurora with the following wave-lengths $\lambda\lambda = 5269$ Å, 5205 Å, 5200 Å, 5233 Å, 5210 Å, 5239 Å, 5207 Å, 5228 Å, 5235 Å, 5166 Å, and 5230 Å, but the list of wave-lengths observed by Vegard in the auroral spectrum and given by him in his paper in the *Phil Mag* of July 1923 contains no wave-lengths between $\lambda = 4708.7$ Å and $\lambda = 5578.2$ Å It appears, however, from a statement in one of his more recent papers, that he has observed in the spectrum of the aurora a trace of a line near $\lambda = 5230$ Å. Cario has found a band in the spectrum of oxygen near $\lambda = 5230$ Å, and Prof A Fowler recently pointed out to me that Ångstrom and Thalen found a negative band in the spectrum of nitrogen at $\lambda = 5227.5$ Å It seems very desirable, then, to repeat the observations on the auroral spectrum to see if there is any trace of a wave-length at or near $\lambda = 5231$ Å If such a spectral line or band should be found, it would be well to have a very exact determination of the wave-length made in order to decide whether the corresponding radiation originates in nitrogen in the gaseous or solid state, or in some other element in one or other of its states

It is unfortunate that Prof Vegard's brilliant prediction has not as yet received experimental confirmation It would appear that neither he nor we have as yet obtained with nitrogen or argon, or with mixtures of these two elements at the temperatures of liquid hydrogen or helium, by the use of any agent, a spectrum that includes a broad line or narrow band within a region of 10 Å on either side of the famous "green line," the wave-length of which, according to measurements made with great precision by Babcock, is $\lambda = 5577.35$ Å Nevertheless, Prof Vegard's theory has been most stimulating, and has led already to the discovery of valuable and important experimental results J C McLennan

The Physical Laboratory,
University of Toronto, December 6

The Life of Lord Rayleigh.

History should have as little fiction attached to it as possible and evidence should be tendered in time, by those who can speak with knowledge this view may not be in accordance with practice none the less, it may be advocated as desirable doctrine, especially as it has the authority of the author of *Zadig*—a saint recommended for worship by Huxley —who has said

> On doit des égards aux vivants,
> On ne doit aux morts que la vérité

All who knew the late Lord Rayleigh even distantly—he was very difficult of approach—will agree with Sir J J Thomson (Nature, December 6, p 814) that his son has written his Life with remarkable skill and sense of proportion—but some of us can scarcely admit that nothing more is to be said even of the discovery of argon The account given is only partial, in no way a complete presentation of the episode, among others, we should like to have heard the views of Gordon, the discoverer's devoted laboratory servitor Lord Rayleigh was but young at the time of the achievement and cannot have been aware of the state of feeling among chemists—nor, probably, was his father, he will not know in what reverence we held his father's work I suppose I was behind the scenes as much as anyone, the more as I was president of the Chemical Society, was thoroughly acquainted with Ramsay and his ways and, as is well known, an intimate friend of Sir James Dewar

At the annual general meeting of the Chemical Society, on March 27, 1895, I made the following statement, to the fellows, in my address

> Your Council have decided to appoint Lord Rayleigh our Faraday lecturer and to request his acceptance of the Medal in recognition of the important service which he has rendered to Chemistry by his discovery of Argon

I handed the medal to him from the presidential chair—he accepted it His guarded remarks in acknowledgment are on record in our Journal The Chemical Society advisedly took the view that it was *his* discovery There was the strongest possible feeling among chemists that his name alone should have been associated with the discovery I may add that, on the same occasion, I had the pleasure of calling upon Ramsay to make public his startling discovery of helium in cleveite, which was thereupon confirmed by Crookes

Lord Rayleigh has dealt mainly with his father's electrical work (on the ohm and the ampere) and that on argon Probably some of his readers are disappointed that he did not also summarise his activity in other directions—particularly his work on oil films and capillarity, which is proving to be of special interest and importance in our field If I be not mistaken, the part he took in such inquiry is not sufficiently recognised. If another edition be called for, let us hope that a chapter on his work in general will be added

As to my friend Sir Joseph Thomson's gibe at chemistry—what is chemistry ? I hold that chemistry and physics are inseparable disciplines, the parting line a broad valley through which both flow; the pity is that physicists so rarely stray from their own region up the chemical slope, that their vision is so little adjusted to our country They suffer, indeed, from *Chemo-myopia*, not *Chemotaxia*, I fear the fault is congenital Apart from Regnault and Rayleigh, I believe determinations of the density of gases are all but entirely the work of chemists—has not Sir Joseph heard of Avogadro's theorem and of one Cannizzaro, a chemist and Roman Senator ? The determination of gaseous density is *the* fundamental operation in chemistry, as he will see if he consult a bygone classic, Cooke's "New Chemistry" Gaseous density is the foundation stone of our entire numerical system What, however, can they know of chemistry who only physics know ? Indeed, there would seem to be a constitutional aversion from our science in the mind of the physicist—he lacks the necessary freedom of outlook to appreciate our numberless excursions. The slowness with which Lord Rayleigh saw the treasure beneath his feet was probably owing to the fact that he had little real chemical feeling, Ramsay at once appreciated the value of the find when asked to inspect the ground and took shares without hesitation Henry E. Armstrong

55 Granville Park,
Lewisham, S E.

The Adhesive Apparatus of the "Sucking-fish."

EARLY in 1923 I published in NATURE a short summary of my views regarding the mechanism of the so-called suckers of certain hill-stream fishes and of the "Sucking-fish"—Echeneis[1] My conclusions were based on an examination of the living specimens of two Indian genera of hill-stream fishes—Pseudecheneis and Glyptothorax, and on a study of preserved material of Echeneis Later, at my request, Major R B Seymour Sewell, Surgeon-Naturalist to the Marine Survey of India, very kindly performed a series of experiments on living specimens of Echeneis Quite recently (September 1924) I have been able to conduct a few experiments on the "Sucking-fish" in the Marine Aquarium at Madras In carrying out these experiments I received great help from Dr Sundara Raj, acting director of the Madras Fisheries, and Prof H Parameswaran, of the Presidency College

The following experiments were carried out to test the sucker-theory of the disc of Echeneis —

A smooth tin sheet perforated all over with minute holes was taken, and the fish was allowed to attach itself to it It was observed that the animal was not able to stick to such a surface This experiment was repeated with a piece of fine-meshed wire gauze in place of the tin sheet with similar results A wooden plank with a large number of parallel grooves running across it at short distances was next used in place of the wire gauze The fish could not adhere to such a surface

In all these experiments it was observed that the fish did not like to have its sucker placed against either very rough or perforated surfaces Moreover, on such surfaces it secreted large quantities of mucus from its disc In all probability this secretion helps the fish in sticking to rough surfaces

The fish was next allowed to adhere firmly to a smooth sheet of glass or a tin sheet It was found that on such smooth surfaces the fish could be made to slide forwards and sideways without any difficulty, but a certain amount of force was needed to pull it backwards or vertically upwards When pulled vertically upwards, the resistance against the pull is due to the sucker formed by the disc, while the force resisting the pull in the backward direction is due to the mechanical frictional device formed by the innumerable backwardly directed spines on the lamellæ of the disc When lifting the fish vertically upwards it was observed that the entire outer rim of the disc formed a big sucker In the next experiment the formation of the sucker by the entire rim of the disc was rendered impossible by introducing a number of match sticks under the rim It was then discovered that a double series of secondary suckers were also formed between the transverse lamellæ on the two sides of the central axis of the disc This was confirmed by gradually lifting the disc from behind, when it was noticed that each secondary sucker gave way with a hissing sound It may also be noted that the secondary suckers produced between the lamellæ are not only independent of the outer large sucker, but are also independent of each other

The disc of Echeneis, when in action, is therefore composed of an outer sucker formed by the rim, and of the two rows of secondary suckers formed in the grooves on either side of the central axis At the same time, the spines on the lamellæ prevent the fish from slipping off whenever the animal is pushed backwards The usefulness of the spines for attachment comes into play when the "Sucking-fish" is adhering to such fast-swimming animals as sharks and whales

The case of the hill-stream fishes is somewhat different They have only to contend against a rapid-running current constantly flowing in one direction Suckers under such conditions are probably less useful than non-slipping frictional devices This is beautifully illustrated by the various Indian species of the genus Garra[2] In species of the genus which live in lakes and comparatively still water (*e g G mullya, G gravelyi*), the mental disc is large, and the adhesive pads on the under surface of the paired fins are feebly developed, while in species which inhabit rapid-running streams (*e g G kempi, G gotyla*) the disc on the under surface of the head is somewhat reduced and the non-slipping adhesive apparatus on the under surface of the paired fins is well developed The frictional device in the case of these fishes is more useful than a vacuum sucker The strength of a vacuum sucker is limited according to its area, while friction increases with pressure, and this in hill-streams increases with the rapidity of the current The similarity in shape between the anterior dorsal profile of the hill-stream fishes and the anterior ventral profile of Echeneis shows similarity of purpose, which is to utilise the force of the current for increasing the pressure on the disc and thus to make it stick more firmly to the substratum SUNDER LAL HORA

Indian Museum, Calcutta,
November 4

[1] Hora, NATURE, 111, p 668 (May 19, 1923) See also Rec Ind Mus 25, pp. 587-591 (1923)

[2] Hora, Rec Ind Mus 22, pp 533-587, pls xxiv-xxvi. (1921)

IN order to test the action and mechanism of the disc in Echeneis and determine whether or not one function of the disc is to act as a sucker (in the strict sense of the word) a series of experiments were carried out

Specimens were allowed to attach themselves to clean sheets of glass, and the disc was then examined and compared with the surface of the disc when unattached In the unattached state the rim of the disc is soft and flexible, and around the anterior half of the disc the margin is distinctly raised while the posterior half is flat, the transverse ridges, on which are numerous posteriorly-directed spines, lie flat against each other and present a practically continuous surface When the animal has attached itself by the disc, the smooth flexible margin can be seen to be closely pressed against the glass The ridges running transversely are now separated from each other by narrow spaces, the two series, *i e* right and left, being separated by a median soft band that passes backwards in the middle line At the posterior end this ridge stops short, so that the terminal posterior part of the sucker is occupied by a single large cavity the floor of which is depressed Air bubbles can be seen between the ridges and in this posterior chamber, and such bubbles may be seen passing along each side of the median partition into the posterior chamber

When thus attached, if the posterior rim of the sucker is separated from the glass, air immediately enters the posterior chamber, and by slowly pulling the sucker away, each pair of spaces between the transverse ridges can be opened separately, each giving way with a slight sucking noise, each compartment of the disc thus appears to act as a separate sucker

When once the fish has attached itself by the disc it can be moved forwards or sideways easily, the disc sliding over the plate, but on attempting to pull the

fish backwards, the spines on the ridges of the disc come into action and tend to prevent any backward movement, and if the disc is forcibly pulled backwards the spines can be heard scraping over the surface If pieces of twine are placed across the disc they prevent the formation of the necessary partial vacuum and the disc fails to adhere, while if the disc is adherent, the introduction of a finger-nail or the blade of a knife between the disc and the surface to which it is adhering allows air to enter and the hold of the sucker is immediately destroyed

Further experiments were conducted in order to try to determine the strength of adherence of the sucker In the first experiment, an Echeneis was allowed to attach itself to the enamel surface of a dish and a hook attached to a spring balance was passed through the gill from one side to the other By standing on the dish and pulling on the spring balance, the amount of force could be fairly accurately measured, and in the specimen experimented with the fish withstood a vertical pull of more than 30 lb before the hook tore through the tissues of the body Further experiments were conducted by allowing the fish to attach itself to an enamel iron tray, the tray being fastened securely by rope to the spring balance The balance was attached to a stanchion, and the head of the fish was seized in a towel to prevent the fingers from slipping on the skin of the fish Two examples withstood a vertical pull of 34 and 35 lb respectively before the sucker was pulled away from the surface

It seems to me that there is little doubt that the disc acts as a true sucker by the creation of a partial vacuum, while the spines are of use in preventing this sucker from sliding on the surface of attachment Thus, during life, when the Echeneis attaches itself to some other larger fish, it is owing to the partial vacuum formed that the disc adheres to the surface, while the spines prevent the Echeneis from being swept backwards by the rush as the large fish makes its way through the water

A further point worth noting is that when the sucker is in action and the Echeneis is attached to any object, all movement of the fish, except that of the mouth and gills that is necessary for respiration, seems to be suspended and inhibited The fish hangs absolutely motionless, and in the case of a fish that had been well hooked, it was found that by allowing the fish to attach itself to a glass plate it would hang motionless, while the hook and a great part of the fish's jaw was cut out! It appears that the action of the sucker causes inhibition of all movement of the body and tail

In order to avoid any misapprehension, may I be allowed to add that my experiments were carried out at the suggestion of Dr Hora, and the above notes, recording the results, were forwarded to him last January

R B Seymour Sewell

R I M S *Investigator*

Transmission of Stimuli in Plants

An article appears on the above subject in Nature of October 25, in which reference is made to Mr Snow's experiments (Proc Roy Soc, Series B, Vol 96, No 678) in support of Ricca's theory that conduction of stimulus in Mimosa is brought about by the transpiration-current in the wood carrying a hypothetical stimulating substance Mr Snow joins two cut pieces of stem of *Mimosa pudica* by a tube filled with water and applies a flame to the lower half of the stem with the result that the leaves of the upper half of the stem undergo a fall, hence it is concluded that stimulus is conducted across the water-gap Mr Snow also finds that the transpiration-current in Mimosa travels at about the same rate as the conducted excitation I have carried out numerous experiments with this plant relating to the supposed transmission across a water column, taking the precaution that the heated air from the flame did not excite the upper leaves. other modes of stimulation were also used which were less open to sources of error In no case did I find any evidence of the transmission of stimulus through the tube filled with water This is confirmed by the results obtained by Prof Koketsu last year, who found that when the petiole of Mimosa was cut into two halves, and rejoined by a water-tight tube filled with water, stimulus applied on the distal half was never conducted across the gap (R Koketsu, Journal of Department of Agriculture, Kyushu Imperial University, Vol 1, p 55, 1923)

I also applied a chemical stimulant, and made a simultaneous determination of the rate of the transmitted excitation and of the rate of transport of the stimulating substance The two rates are of very different order, that of the transmission of excitation being at least a hundred times the quicker The slow transport of a stimulant or of a hormone, and the rapid transmission of excitation, ought not to be confused with each other I have carried out numerous experiments which prove conclusively that the transpiration-current has nothing to do with the conduction of the excitatory impulse.

In the article referred to above, I find no reference to my earlier researches on the transmission of excitation in Mimosa, some of which were published so far back as eighteen years ago ("Plant Response," 1906, "An Automatic Method for the Investigation of Velocity of Transmission of Excitation in *Mimosa*," Phil Trans, 204, B, 1913, "Irritability of Plants," 1913, "The Dia-heliotropic attitude of Leaves as determined by Transmitted Nervous Excitation," Proc Roy Soc, B, Vol 93, 1922) These researches proved conclusively that the *conduction is a phenomenon of propagation of protoplasmic excitation* This was proved by numerous experiments of a crucial character Among these may be mentioned the characteristic polar effect of a constant current in protoplasmic excitation I have shown that an excitatory impulse is initiated at the cathode at "make" and at the anode at "break" of the current, the excitatory impulse being afterwards transmitted to a distance I have shown, moreover, that the interposition of an electrotonic block arrests the excitatory impulse in the conducting tissue of the plant as in the nerve of the animal The above results have since been fully confirmed by Koketsu The characteristic effects described above disprove the theory that the transpiration-current is concerned in the conduction of excitation A full account of my more recent experiments will, I hope, be published shortly

J. C Bose.

Bose Institute, Calcutta,
November 20

An Approximation to the Probability Integral.

Referring to Prof H C Plummer's letter on "An Approximation to the Probability Integral," published in Nature of October 25, the following alternative way of representing the normal error function by simple approximation may be of interest The original demonstration of this has been given by me in Physical Department Paper No 8, "A Method of Curve Fitting"

Let us write as follows the equations for the three variables x, y, z

$$z=\frac{a}{\sigma\sqrt{2\pi}}e^{-x^2/2\sigma^2}, \qquad (1)$$

$$v=\int_0^x z dx \qquad (2)$$

In the above-mentioned paper it is shown that the equation

$$z=k\left(\frac{a^2}{4}-y\right)^{0·8111} \qquad (3)[1]$$

gives a very close approximation to the values taken from a Probability Integral Table. The numerical value of k may be computed from

$$k\sigma=\frac{1·2318}{a^{0·0222}} \qquad (4)$$

Now, eliminating z from equations (1) and (3)

$$y=\sqrt{\frac{a^2}{4}-10^u}, \qquad (5a)$$

$$u=\log_{10}\frac{a^2}{4}-0·2677\left(\frac{x}{\sigma}\right)^2 \qquad (5b)$$

Putting $a=1000$, the following Table shows the degree of accuracy of the equations (3), (5), and of Prof. Plummer's formula.

From Prob. Integral Table			From (3)	From (5)	Plummer's
	z	y	z	v	y
0·0	398·9	0	400·1	0	0
0·5	352·1	191·5	351·8	189·0	191·5
1·0	242·0	341·3	240·6	339·2	342·0
1·5	129·5	433·2	129·7	433·1	435·1
2·0	54·0	477·3	56·3	478·3	478·8
2·5	17·5	493·8	19·9	494·7	488·4
3·0	4·4	498·6	5·6	499·0	
3·5	0·9	499·8	1·3	499·9	

Prof. Plummer's formula may be used only up to $x/\sigma=\sqrt{6}=2·449$ (see NATURE of October 25). It is simpler than equation (5), and is to be preferred whenever values of v are quickly wanted for small values of x. However, in practical statistical work, problems may arise requiring one of the variables x, y, z to be determined in terms of one of the other two over the whole of the range of x. For such cases, when great accuracy is not wanted, the above equations may be useful to replace Probability Integral Tables. The variable x may be computed in terms of y from equations (1) and (3).

S. KRICHEWSKY

Physical Department, Cairo,
November 22.

[1] The exponent of equation (3) has been previously given as $=0·7864$ and has been recently corrected to 0·81111 by more rigorous methods. Equation (4) has been correspondingly corrected.

The Word "Scientist" or its Substitute.

I DO not think exception can fairly be taken to the adoption into a living language of any word that (1) contributes to convenient expression and (2) violates no rule or custom in etymology. Contemporary speech has this advantage over a dead language as a vehicle of thought, that it can be adapted to changing circumstance, whether that be effected by modifying the meaning of old vocables or by the addition of new ones. The invention of printing did much to arrest colloquial change and to standardise speech, but a useful measure of elasticity still prevails. Examples in point are the verbs "to burke" and "to boycott," which it would be very inconvenient to discard.

It has been pointed out by correspondents in NATURE that there is plenty of analogy in sound English for the formation of "scientist" from "science." Sir E. Ray Lankester objects to the term because there is no precise definition of science; but surely we all know what is meant by a "man of science," for which term "scientist" seems a neat synonym, standing aptly in antithesis to "sciolist"—one who has a smattering of some branch of knowledge.

HERBERT MAXWELL.

Monreith, Whauphill,
Wigtownshire.

WRITING as a student of the history of words, "scientist" can never become a *permanent* part of any language, for its quantity is "impossible." It has a destructive effect in a sentence, and when spoken the last syllables must be gobbled. "Naturalist" may be gobbled fairly easily; few people notice it; but "scientist" is difficult. So perhaps it scarcely matters whether the word receives or not the approval of the dictionaries; words which we instinctively feel are repulsive drop out of use.

The only possible salvation for the word is for its advocates to introduce the more correct pronunciation "scientist," that is, middle syllable accented. Thesist, logist, are alternatives which suggest themselves; the latter would be in conformity with "biology" and the many other "logy's."

REGINALD A. FESSENDEN.

45 Waban Hill Road,
Chestnut Hill, Mass.,
December 15.

The Spectrohelioscope.

I AM very glad to learn from NATURE of November 8, p. 683, that Mr. F. Stanley is also engaged in developing a spectrohelioscope. In my long focus (13 feet) instrument, where the slits are rather narrow and hence close together in order to give sufficient light with the requisite purity, the motion of the spectral line is practically equal to that of the slit for the small displacements from the optical axis involved. Thus it is possible to avoid the use of such deflecting prisms and gearing as Mr. Stanley employs. I have not yet attempted, however, to design a short focus instrument.

A rotating disc with radial slits makes a natural appeal to the instrument designer and I used it for my first (unsuccessful) experiments, made on Mount Wilson with the 30-foot spectroscope of the 60-foot tower telescope many years ago. It will serve very well with a moderate number of slits when there is sufficient light, but the high purity required for observations of the hydrogen flocculi complicates the problem. For example, in order to obtain with a disc the purity and brightness I now command with an oscillating bar (carrying two sets of five slits each), it would be necessary to use about 400 radial slits, each 0·003 inch wide and with errors of spacing less than 0·001 inch. This can, of course, be done, and I shall probably try it, but the simple oscillating bar suggested itself as an easy means of making a rigorous test of the method for the exacting task of observing the hydrogen flocculi against the brilliant disc of the sun.

GEORGE E. HALE.

Pasadena, California,
December 3.

The Compton Effect.

APROPOS of the very readable review of the discussion on scattered X-rays at the Toronto meeting of the British Association, published in NATURE of October 25, p 627, we presume your readers may be interested in a bit of new evidence on the reality of the Compton effect, obtained since that meeting

We have photographed spectra of scattered molybdenum rays, with the tube and scatterer in one room and the spectrograph in another The walls near the tube and scatterer were lined with lead, and the room was large enough to remove all other substances exposed to the rays to a safe distance By that we mean a distance such that even if those substances converted all the radiant energy falling on them into tertiary rays, the total quantity of tertiary radiation sent by them to the "scatterer" would be reduced by the inverse square law alone far beyond detection We built two such sets of apparatus, in different parts of the room, and used them at different times One was a molybdenum-target tube with a sulphur scatterer The other was another molybdenum-target tube, of a different form, with an aluminum scatterer, using a spectrograph of quite a different design

Both of these sets of apparatus gave spectra like those described previously by Ross (*Phys Rev*, Nov 1923, Proc Nat Acad Sci, July 1924), which had given the first definite proof of the existence of the Compton effect in elements other than carbon These new spectra showed the Compton-theory lines as strong as in the earlier spectra Apparently, therefore, these experiments confirm the calculations described at the Toronto meeting showing that those spectra were quite free from any contamination by box effects, and were due only to the elements to which Ross ascribed them

D L WEBSTER
P A ROSS

Stanford University, California, U S A,
December 3

Arsenic in Oysters.

YOUR contributor J S G in reviewing (NATURE, December 20, p 913) the report of the Ministry of Agriculture and Fisheries on oyster mortality in 1920, and dealing with the finding of 3 7 parts of arsenic per million in oysters from certain beds, comments on the serious questions raised by such a fact A definite pronouncement is needed as to what constitutes danger As is well known, the Royal Commission on Arsenical Poisoning, in its report in 1903, recommended that no substance used in the preparation of food should contain more than 1/100 grain per lb This recommendation has been adopted as a standard for years, and many prosecutions have been successful for quantities but little in excess of this Surely the position is now more illogical than ever it was Is the fishmonger to be prosecuted if his oysters have three parts per million (1/50 grain per lb), and, if not, why should a grocer be charged if, say, a baking powder—probably not made by himself—contains this amount?

Results of investigation in Sweden show that fish may have an arsenic content up to four parts per million, and my own analyses of fish sold in the London market, recently communicated to the Society of Public Analysts, confirm this figure in respect of certain plaice The administration of the Sale of ood and Drugs Acts in this respect requires revision.

H E COX

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December 24

Convective Equilibrium.

THERE is a rather important consideration connected with the production of cloud in rising air currents (which does not seem to have received attention) the effect of which is to check uprushes of moist air

I have often noticed the cumulus clouds over a distant thunderstorm suddenly cease to rise and then disappear Whilst rising, their outlines are clear and sharp As soon as the rise ceases their outlines become indistinct Then a partially transparent veil appears where the cumulus cloud was, and this fades away entirely, leaving the atmosphere clear Why do cumulus clouds fail to rise so high as one would expect them to?

Warm saturated air near the earth's surface (warmed by proximity to the ground) rises and steadily cools After the dew point is reached important results follow Condensation takes place and the air is then prevented from falling in temperature so much as it would do if it were dry, and this would accelerate the velocity of the up current if it were not for the presence of the *newly formed cloud particles* The small drops forming the cloud are floating in the air and contributing their quota to its weight Condensation thus tends to check the ascent of the mass When the particles become large enough to descend quickly, as rain or hail, they draw the air down with them and the uprush ceases

The mechanical effect of falling rain, and the great density of a cloud due to the weight of the water particles in it, do not seem to have been generally considered

R M DEELEY

Tintagil, Kew Gardens Road,
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December 24

Molecular Dimensions of Celluloid.

THE results of the experiments carried out by the Bureau of Standards, Washington (NATURE, December 13, p 861), are of very great interest, but would be still more valuable if the exact composition of the "celluloid" were known There is often confusion in referring to such words as "celluloid," "celloidin," "collodion" and the like Celluloid, the basis of photographic film, is certainly a manufactured mixture of variable composition, containing among other ingredients a considerable percentage of camphor, the main ingredient being, of course, a soluble cellulose trinitrate, though cellulose acetate is now being increasingly used on account of its non-inflammability It is, therefore, scarcely correct to speak of the "molecular complex of celluloid" (unless "complex" is intended to cover a mixture of two or more compounds). "Celloidin" is the trade name of a carefully purified and soluble cellulose nitrate, probably approaching to a single chemical substance Collodion is, of course, a solution of nitro-cellulose in acetone, ether-alcohol, or some other organic solvent

HENRY GARNETT

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Heaton Moor,
near Stockport,
December 14.

ERRATUM—In NATURE of October 4, p 499, a letter from Prof Was Shoulejkin on "A New Method of Investigating Sea Waves" is subscribed "Technical High School, Moscow" The work described was carried out at the Physical Institution of the Science Institution of Moscow

The Theory of Evolution since Darwin.[1]

By Prof. E. W MACBRIDE, F R S.

NO event in the intellectual world has had such a profound influence on the mental outlook of mankind in general as the publication of the "Origin of Species" by Charles Darwin in 1859 A distorted version of the theory embodied in it figured largely in the propaganda that led to the Russian revolution Nothing could be more interesting to the student of the history of thought than to analyse the ideas and assumptions involved in this theory and to trace their fate in the subsequent course of scientific criticism

The outlines of Darwin's theory are familiar to all, and the technical terms which he introduced—"natural selection," "the struggle for existence," "the survival of the fittest"—have passed into everyday language It is to be noted that he termed his theory "Descent with modification," and that the name "evolution" was first applied to it by Herbert Spencer This is significant, because in Herbert Spencer's mouth, evolution denoted a general theory of everything that was going on in the universe, of which the development of animals and plants formed only a small part We must emphasise, therefore, the fact that Darwin takes life and the fundamental properties of living things for granted, he does not strive, like Spencer, to explain them in terms of matter and motion

Founding on what he could observe of the nature of life as he saw it, Darwin strove to argue back to what was the condition of the living world in past times and what are the influences at work in modifying it at the present time He assumed that animals and plants are continually giving rise to small variations in all directions and that these variations are inheritable This is the positive idea which is embedded in what is generally called the theory of "natural selection" For "natural selection," the death of the many and the survival of the few, is only the pruning knife and can of itself originate nothing new These random variations Darwin attributed not to chance but to the environment, which, as Darwin imagined, produced an instability in the hereditary qualities of organisms which are exposed to new conditions But besides this effect, Darwin asserted that the results of increase in size of organ by use and its diminution in size by disuse were inheritable He was driven to this assumption by the endeavour to account for the disappearance of unused organs in such cases as that of cave-animals which had lost their eyes. He could not conceive how small decreases in size in organs which were no longer used could give their possessors the victory in the struggle for existence Darwin imagined, further, that the struggle for a bare existence was in many species accompanied by a struggle to find a mate, a struggle which was undertaken by the male; and he attributed the varied peculiarities of colour, shape, ornaments, and voice which distinguished males from females, to the preference of the female for the most attractive male. The results of this supplementary struggle were termed by Darwin "sexual selection." This part of the theory has not met with general acceptance, and we can therefore leave it out of account

The difficulties in his theory which Darwin felt most acutely were the beginnings of useful organs from small useless rudiments and the origin of the sterility which usually exists between allied species The first difficulty has been largely removed by the progress of embryological research, for it has been shown that new organs do not originate from useless rudiments but by the modification of older and simpler organs, but the second difficulty has not been fully solved even to-day Believing as he did that allied species were only more sharply differentiated local races of the same species, Darwin yet had to admit that local races were mutually fertile, and that allied species when crossed were sterile He pointed out that sterility could arise between members of the same species as it has done in the case of the primrose, and he imagined that sterility was, so to speak, a by-product of increasing divergence of constitution

Of course, as Darwin himself pointed out many naturalists before him had interpreted the likenesses of allied species as evidence of blood relationship, and had even put forward speculations as to the course of evolution, but the weak point in all these theories had been that they did not point to causes now in existence by which evolution could have been brought about The first effect of Darwin's theory was to convince scientific men, especially naturalists, that evolution really had occurred and that it was in fact still going on The feature in the theory which secured their assent was "natural selection." It seemed to his contemporaries that Darwin had laid hold of a fact which, when once attention was directed towards it, no one could deny, namely, the death of the many and the survival of the few It is true that Lamarck had previously relied on natural causes, such as the effects of use and disuse and the production of new habits as the agents in evolution, and I myself believe that he was in great measure right, but the changes of habits in animals which he postulates are phenomena which are slow in their effects and do not constantly occur, and they are not easily observable within the limits of a human life. Moreover, the facts which now give support to Lamarck's views were not known when he wrote, nor even when Darwin wrote, and hence Lamarck failed to produce an effect on contemporary thought at all comparable to that which was effected by Darwin.

Huxley in England and Haeckel in Germany were the great champions of the evolutionary principle against theological opponents Haeckel[2] made to the theory one great addition which is of far-reaching consequence. it had been dimly perceived by Darwin and is hinted at in the "Origin of Species," but it was first clearly enunciated by Haeckel. In his "General Morphology," first published in 1866, he stated that "Ontogenesis, or the development of the individual, is a short and quick repetition (recapitulation) of phylo-

[1] From a lecture delivered at King's College, University of London, on November 28, for the Board of Studies on the History, Principles, and Methods of Science

[2] My friend Prof Dendy has pointed out to me that Haeckel derived his "Law of Biogenetics" from Meckel, who wrote in 1827, but as Meckel was opposed by von Baer, the great comparative embryologist of the day, his views were ignored

genesis, or the development of the tribe to which it belongs determined by the laws of inheritance and adaptation" This in shortened form, "Ontogeny is a recapitulation of Phylogeny," was called the "Fundamental Law of Biogenetics."

The validity of this law Haeckel sought to establish by numerous examples, and he has been accused, apparently with justice, with misrepresenting some of the facts in order to bring them into conformity with it He is said to have made four separate drawings of the same embryo and to have labelled them with different names so as to show the identity of the early embryonic form in four different groups This was detected, and together with the wildness of much of Haeckel's speculation tended, especially in Germany, to produce a strong reaction against most of Haeckel's teaching But in spite of Haeckel's unscrupulous action he was in many respects a far-reaching genius Though some naturalists have affected to disbelieve in the biogenetic law, in practice, in their morphological reasoning all assume its validity Even Haeckel's special theory, namely, the derivation of the higher animals from a single hypothetical hydra-like ancestor, which he called the "gastræa," has received more and more confirmation as embryological research has proceeded

Haeckel never thought that variations could be due to chance, on the contrary, he attributes them all to differences in nutrition Some which we call "directly adaptive," like the effects of use and disuse, which alter the flow of blood to an organ and so change its nutrition, show their effects in a single generation, whilst others which he calls "indirectly adaptive" only make themselves felt in the next or succeeding generations He says that the "superiority of Englishmen is due to their being fed on excellent beef, but the beef results from the cattle being grazed on rich clover pasture Clover is fertilised by wild bees, but wild bees are decimated by field-mice, which are kept in check by cats Cats are usually kept by old maids, and therefore this peculiarity of unmarried females is the original cause of British pre-eminence"

Huxley, though he contributed immensely to the building up of a scientific zoology on the basis of Darwin's theory, added nothing to the theory itself, but one of his sayings may be quoted as showing his insight into the matter at stake "We have got our theory of evolution, what we want now is a good theory of evolution" We shall find that practically all subsequent criticisms of what for brevity's sake we may term Darwinism turn on these two questions, namely (1) What is the nature and cause of variation? (2) Why are species usually mutually sterile?

We have already directed attention to the fact that the development of animals and plants from simpler ancestors was included by Herbert Spencer in his theory of evolution, a theory intended to explain everything that was going on in the universe on the basis of the laws of mass and motion But Spencer laboured under all the disadvantages which beset those who write treatises on subjects with which they have only a second-hand or superficial acquaintance It is true that in his "Principles of Biology" he sees clearly that the vital point at issue in Darwinism is the origin of variations, and he throws his whole weight on the side of the inheritability of the effects of use and disuse But his arguments are not convincing, since they always involve a "petitio principii", he never seems to see that a thorough experimental examination of the subject is necessary, but considers that his point is proved by vague plausible suggestions He suggests that animals are made up of "physiological units," and that these units become modified in response to changed conditions and are then passed into the germ-cells and make their effect felt in the next generation This conception resulted from his comparison of the regeneration of the limb with the self-completion of a broken crystal in its mother liquor, a conception which we now know to be utterly futile and misleading No doubt Spencer did much to popularise the idea of evolution with the general public, but it is impossible to point to one addition of any scientific importance which he made to the theory of evolution

It is true that Darwin in a later and far too imperfectly known book, "The Variation of Animals and Plants under Domestication," put forward a suggestion somewhat similar to that of the "physiological units" to explain the origin of variation This is the theory of "pangenesis" According to this hypothesis, every part of the body of animal or plant is continually throwing off "gemmules" which are endowed with the power of multiplication and with the capacity, in suitable circumstances, of growing into the likeness of the part from which they came These gemmules are carried from part to part by the circulation, and they accumulate in the germ-cells They become altered in character in accordance with the alteration of the part from which they come, and when sufficient of the altered gemmules have accumulated in the germ-cells, the alteration becomes hereditary Darwin's gemmules, however, are living units endowed with the characteristic vital properties of growth and reproduction, whereas Spencer's physiological units are merely large organic molecules

The next important event in the history of the theory of evolution is the advent of Weismann, who in 1885 published his "Essays on Heredity," which were later consolidated into a book termed "The Germ-Plasm" Until his time it had been tacitly assumed that the effects of use and disuse could be inherited, and the only reason for refusing to assign to them the exclusive importance attributed to them by Lamarck was the difficulty which many naturalists felt in explaining some evolutionary changes by the accumulation of the results of efforts on the part of the animals or plants which exhibited them But Weismann challenged the validity of the whole of the Lamarckian doctrine, and this he did on two grounds first, that the evidence in favour of acquired characters was not sound, and secondly, that on account of the structure of what he calls the "germ-plasm," acquired qualities could not be transmitted He therefore sought to explain the origin of variations by what I can only term the accidents besetting the ripening of the egg Since all the father's potencies in heredity are contained in the sperm-head, which is a condensed mass of chromosomes equal in number to those in the ripe and unfertilised egg, the real bearers of hereditary powers must be the chromosomes

If now we suppose that a single chromosome, which Weismann terms an "idant," nay, even a portion of a chromosome which he calls an "id," is theoretically capable of carrying out the entire development of the species, but that different "ids" would give rise to slightly different types of development and that the actual development of the egg is a compromise between the potencies of the various "ids," we arrive at the Weismannian explanation of variations. If it is mere chance which group of "ids" are thrown out of the nucleus when the number of chromosomes is halved at ripening, then obviously all sorts of different groups may be left in the make-up of the various eggs and various sperm-cells, and these different groups will give rise to different inheritable variations of which natural selection will preserve those best adapted to the circumstances of the animal

But why should the various "ids" differ from one another? To this question an extraordinary answer was given by Weismann. When a cell divides, the nucleus divides first and each chromosome gives rise to daughter chromosomes by longitudinal splitting, which then by nourishing themselves at the expense of the protoplasm grow as big as their parent During this growth, variations in nutrition of the daughters are the causes of variations in their structure which are handed on to their posterity at the next division! So that the very principle which Weismann rejects at the beginning of his hypothesis, he reintroduces in dealing with the chromosomes, namely, external circumstances giving rise to inheritable variation Let us now glance for a moment at the way in which the theory is worked out in detail The fertilised egg begins its development with a selected group of "ids" derived in equal proportions from the father and the mother; each of these "ids" contains within it the entire potency to bring about the development of the adult form When the egg-cell divides, the division, though apparently an equal one, is in reality unequal—one daughter retains the "ids" undisturbed, but in another the 'ids" have already undergone decomposition and are now represented only by "determinants," each of which has only the potency of causing the development of that part of the body to which this daughter-cell will give rise As development continues, the determinants suffer further decomposition until at length they are resolved into "biophores," which have only the capacity of conferring on the cell in which they lie the power to become a muscle-cell, a nerve-cell, a gland-cell, etc The descendants of the other daughter-cell of the original two, however, receive unbroken "ids" and eventually give rise to the germ-cells of the next generation Their lineage is called the "germ-track"

On the Weismannian hypothesis, then, the germ-cells are separated from the body at the very beginning of development and are not afterwards influenced by what happens to the body during its growth, and Weismann, with true Teutonic thoroughness, having formed this conception of the structure of animals, declares it be *a priori* impossible that acquired characters, *i e* new habits, could affect the germ-cells, since, as he states, he can form no conception of how the change in structure resulting from a changed habit can be represented in the nucleus of the germ-cell The experiments alleged to prove the inheritance of acquired qualities which were available to Weismann were supposed examples of the hereditary transmission of mutilations, these he sought to explain away, and he cut off the tails of mice and bred from these maimed animals, and showed that the offspring did possess well-developed tails

Weismann's doctrines obtained wide acceptance, and were regarded as finally disproving the environmental origin of variations, and the position remained practically unchanged until the beginning of the twentieth century

We may now pause for a moment to take up the question of the sterility between species In 1897, Romanes, a Cambridge man who had migrated to Oxford, published a book entitled "Darwin, and after Darwin" In this book he considers the question of how two divergent species could have arisen from one, and he points out that it is inconceivable that this could have happened by the natural selection of accidental variations, unless two portions of the original species had become isolated from one another so that cross-breeding was prevented Romanes puts forward the idea that owing to accident (*i.e* unknown causes) physiological variations occurred, so that two portions of the same stock became mutually sterile. He thinks that geographical isolation is insufficient to account for the appearance of sterility, because species occupying adjacent territories are often mutually sterile, and he cannot conceive how what seem to him slight differences in climate can effect so great a change as sterility, but as to the causes of the appearances of this "physiological isolation" he gives no hint whatever. No further light was thrown on this subject until the last year or two, when Goldschmidt took up the question of the mutual fertility of local races of the same species when crossed. He showed in the case of the gipsy moth that when two races from widely separated localities are crossed, sterile intersexes are often produced which render the continued propagation of the mixed race difficult His results therefore support Darwin's hypotheses of sterility as a by-product of increasing divergence of constitution

The twentieth century began with two events of decisive importance for the theory of evolution, namely, the rediscovery of Mendel's researches by Correns in 1900 and the publication by Johannsen in 1903 of a paper entitled "The Bearing of Pure Lines on the Theory of Inheritance" Mendel's researches, which were carried out at the same time as Darwin's work and published soon after the publication of the "Origin of Species," appeared in local journals of too limited circulation, and attracted no notice from the general scientific world. They had in Mendel's mind no relevancy to the formation of species whatsoever, but were concerned only in discovering the laws governing the distribution of paternal and maternal characters amongst hybrid offspring Mendel in his experiments always chose varieties sharply separated from one another by definite clearly-cut characters The rediscovery of Mendel's work gave a great impetus to the carrying out of experiments in crossing all kinds of variants from the normal with the type In these experiments Bateson in England and Morgan in the United States took leading parts, and it was soon dis-

covered that those sudden deviations from the normal which turn up without assignable cause in most breeds of domestic animals and varieties of cultivated plants obey the Mendelian rules when crossed with the types Johannsen's results proved the non-inheritability in the case of beans of those small random deviations from the normal in all directions on which Darwin had laid such stress, and these results were independently confirmed by Jennings, who worked on Protozoa, and by Agar, who studied small Crustacea (1912)

In consequence of these discoveries, biological opinion veered round in favour of regarding the conspicuous aberrations commonly known as sports as the raw material on which natural selection had worked Darwin, it is true, had considered the question of whether sports might not be the starting-point of new species, and had decided that they could not be so on account of the rarity of their occurrence He thought that the chance of such a sport mating with its like, even if highly successful in the struggle for existence, was infinitesimal, and that if it did not mate with its like its characters would be "swamped by intercrossing" But if the deviation were in a direction favoured by natural selection, it might be assumed that it would make itself felt in lesser degree even when its orginal possessor crossed with the type, and the first generation descendants might still survive on account of its lessened manifestation Many have claimed that this argument is strongly reinforced by the discovery of the laws of Mendelism For if the deviation behaved as a dominant when crossed with the type, all the first generation of the descendants of such a cross would show it in as strong a manner as its orginal possessor, and even if it were recessive it would appear in undiminished strength amongst one-fourth of the second filial generation The real objection to regarding sports as the initiators of new species lies deeper An animal does not survive on account of one organ In its growth from the egg to the adult, it runs the gauntlet of many dangers, and a strong development of some one organ might determine its survival at one period of its existence, but if the deviation occurs very rarely the chances against that particular animal reaching the critical stage at all are enormous.

De Vries, the director of the botanical gardens at Amsterdam, carried out between the years 1886 and 1899 a series of cultures of the garden plant *Œnothera Lamarckiana*, commonly known as the evening primrose He showed that every year a number of sports turned up, usually about half a dozen in 10,000 specimens, sometimes as many as three in a hundred, and that this sports usually, though not always, bred true when crossed with their like De Vries called these sports "mutations," and imagined that he had surprised a species in a "fit of mutation," and that new species were not produced by a slow process of differentiation but by sudden jumps, so that they began their existence complete in all their details, as Minerva sprang from the head of Jove The De Vriesian doctrine joined with Mendelism, and became the dominant doctrine of evolution and heredity for most of the first quarter of the twentieth century, and probably counts amongst its adherents a larger number of biologists than any other doctrine at the present time It was first seriously put forward by Bateson in 1894 in a book entitled "Materials for the Study of Variation," in which he figured and recorded a large number of examples of monstrous deviations from the normal, and laid down two doctrines, one of which is undeniably true, whilst the second is really the De Vriesian theory The first was "variation is evolution", the second, the "discontinuity of species is due to the discontinuity of variation"

The De Vriesian view has reached its climax in a book termed "Age and Area" by Dr Willis, a distinguished botanist This book was published two years ago, in it Dr Willis supports the idea that species originate in sudden inexplicable jumps which occur only rarely This idea is difficult to distinguish from the pre-Darwinian doctrine of special creation No wonder that Haeckel, who lived long enough to encounter this view in its early presentation by Bateson, said · "If views like this are to be accepted, it would be better to return to Moses at once"

(*To be continued.*)

Biographical Byways.

By Sir ARTHUR SCHUSTER, F R S

INTRODUCTION

THERE are things seldom referred to in obituary notices and sometimes omitted even in more ambitious biographies They tell the tale of peculiarities or weaknesses, which the writer fears may detract from the merits of the man he has set out to praise The biographer believes, with some show of justice, that his main object is to give a record of work accomplished and not a psychological analysis of character But eccentricities, or even decided failings, form part of a man's personality The extent to which his teaching carries conviction and affects the scientific outlook of his time, depend as much on his personal attributes as on the merits of his researches We destroy the balance of a just valuation, if we ignore those shades of character or temperament which act as handicaps to the full fruition of his work

It has been my good fortune to be acquainted personally with many of the men who laid the foundations of the science of the nineteenth century, and I have retained a vivid memory of such intercourse as I had with them In writing down some of my recollections I have tried to outline personalities in a sympathetic spirit If human frailties are sometimes exposed, I hope that the limits of allowable candour have never been transgressed, and that, apart from the personal factor, the incidents related may be found to contain some substantial contributions to the history of science during the middle period of last century

1 URBAIN JEAN JOSEPH LEVERRIER (1811–1877)

Towards the end of December 1874, or nearly in the year 1875, I received an invitation from the Royal Society to take part in an expedition which was being

organised to observe the total solar eclipse of April 1875 in Siam Norman Lockyer was expected to act as leader of the expedition, which was to start in February; the time for preparation was therefore short Ultimately Lockyer, who was then acting as secretary to the Royal Commission on Science Teaching presided over by the Duke of Devonshire, did not obtain the leave of absence he had expected, and I was put in charge I had never had any experience in mounting or dismounting astronomical instruments, or indeed in using them, and one of the appliances on which we depended—a large siderostat—was under construction and not expected to be ready before the eve of our departure It was essential that I should get some knowledge of the instrument, and more especially of the process of silvering the mirror, which was to be a foot in diameter. A similar siderostat was in use at the Paris Observatory, where M. Adolphe Martin had found a simple and convenient method of silvering large surfaces of glass I was therefore sent to Paris, the consent of Leverrier, the famous director of the Observatory, having been obtained

I first called on Cornu to ask advice on some optical questions that had arisen and, needless to say, I met with a most friendly reception both from him and other scientific men, notably Jamin When Cornu heard that I was to call on Leverrier, he shook his head and said · " Je ne sais pas si M Leverrier est l'homme le plus détestable à Paris, mais je sais que c'est l'homme le plus détesté " This was not encouraging, and it was in fear and trembling that I entered the Observatory.

I was received by one of the assistant observers, C. Wolf, who remarked with a look full of sympathy "You will find M Leverrier in a very bad temper he has just returned from a funeral." I was then barely twenty-three years old, and naturally looked upon Leverrier (who was then sixty-four) as one of the formidable veterans of science. I was ushered into the "Presence," received with a searching look and the abrupt question: "Qui êtes-vous et que voulez-vous ici ?" I mildly answered that I understood Mr Lockyer had written to explain the purpose of my visit "So he has," said Leverrier, "but I want to hear it from you" After I had replied to the best of my ability, I was dismissed with the remark: "I have already given instructions that every assistance should be given you"

I spent an interesting and instructive week practising Martin's silvering process, which has the great advantage that the surface comes out polished, except for a thin veil which is easily removed without appreciable friction When it was time to return home, I suggested to M. Wolf that it might be sufficient for me to write a letter of thanks to Leverrier without troubling him with a personal call. But Wolf would not hear of this, and I was shown again into the "lion's den" Leverrier was sitting at his desk, and by his side stood a trembling young assistant to whom he continued to speak, taking no notice of me I listened to a conversation of which I remember the main points without pretending to literal accuracy

LEVERRIER. And so you tell me, that after trying for a whole week you have not yet found the mistake in your calculations ?

ASSISTANT. No

LEVERRIER. You have, of course, applied the correction for . . . (I did not catch the details)

ASSISTANT Yes

LEVERRIER Did you apply it with a plus or a minus sign ?

ASSISTANT. Plus

LEVERRIER. It ought to be minus That is your mistake Go and correct your calculations

After the assistant had left the room, Leverrier chuckled. "I knew all along," he said to me, "what his mistake was, but I wanted to see whether he could find it out by himself"; and to my great surprise he continued, "come and have a walk round the garden" All traces of peevishness and severity had disappeared, and for half an hour or more he became a most interesting and encouraging talker A new reflecting telescope was just being erected in the grounds of the Observatory, and he explained the uses to which it might be put, inviting me, whenever I felt inclined, to come and work with it

He then began to speak on a subject on which he evidently felt very strongly Great preparations had been made in the previous year, and much money spent, on fitting out expeditions to observe the transit of Venus, which had just taken place on December 8, 1874. The French Government had followed the example of other countries, but against Leverrier's advice It was, of course, well known to astronomers that he preferred other methods of determining the solar parallax; but the Government would not listen to his advice "Que voulez-vous ?"—France had recently been defeated in war, and if she did not share in international work, the Government was afraid that its action might be misinterpreted and believed to be due to sulkiness or want of funds But Leverrier strongly expressed his opinion that the money was all wasted, and that neither this nor the subsequent transit of 1882 would add anything of value to our knowledge. In this he proved to be perfectly right

2 JOHN PRESCOTT JOULE (1818–1889)

I once asked Joule what he felt like when he heard that one of his papers was rejected by the Royal Society "I was not surprised," he answered, "I could imagine these gentlemen in London sitting round a table and saying to each other. 'What good can come out of a town where they dine in the middle of the day'"

There are some interesting and somewhat puzzling circumstances connected with the fate of that paper, which was communicated to the Royal Society by one of its secretaries, Peter Mark Roget, on October 16, 1840 Under the title "On the Production of Heat by Voltaic Electricity," it contained the account of an experimental investigation which had led Joule to formulate his all-important law, that the heat generated in a conductor by an electric current is proportional to the product of the resistance and the square of the current. The paper was read on December 17, and in due course a short abstract appeared in the Proceedings which gave the final result arrived at, and hence secured Joule's priority. It is, therefore, not quite correct to say that the paper was rejected. The difficulty arose in connexion with its publication *in extenso*. The paper was short—it would not have taken up more than four or five pages in the Proceedings—and it was perhaps

considered that such far-reaching results could not be proved by the comparatively few experiments conducted by Joule Criticisms were also made on the ground that previous investigations on the same subject were not mentioned On March 11, 1841, the communication was committed to the Archives

A paper carrying the title "On the Heat evolved by Metallic Conductors of Electricity and in the Cells of a Battery during Electrolysis" shortly afterwards appeared in the *Philosophical Magazine* It bears the date March 25, 1841, and its introductory paragraph concludes with the sentence

> "I hope therefore that the results of my careful investigation on the heat produced by voltaic action are of sufficient interest to justify me in laying them before the Royal Society"

This remark has naturally led to the belief (definitely expressed by Osborne Reynolds in his extensive memoir on Joule published by the Manchester Literary and Philosophical Society) that the paper, as printed in the *Philosophical Magazine*, is the one declined by the Royal Society This, however, is not the case The difference in the title is significant. The Royal Society paper deals with solid conductors, covering only the ground which in the *Philosophical Magazine* appears as "Chapter 1," and is there followed by a second chapter, twice as long, dealing with electrolysis and adding considerably to the range and importance of the results Even in the first part the two papers are not identical, only a few short paragraphs being unaltered—though it must be admitted that the alterations are not material. It is not at all certain whether the complete paper as it appeared in the *Philosophical Magazine* would have been declined by the Royal Society, but it is perplexing that the reference to the Royal Society has been left standing in the altered and extended paper

We cannot suppose that Joule deliberately wished to convey a wrong impression, and only one explanation seems to me to offer itself It may be surmised that some correspondence took place in the three months between the date at which the paper was read and that at which it was committed to the Archives On being informed of the objections raised, Joule may have prepared a more complete account to be substituted for the paper originally submitted; but the Royal Society having finally declined to print the original paper *in extenso*, he was quite likely to forward the amplified version to the *Philosophical Magazine*, the reference to the Society in the opening paragraph being left standing by an oversight

It is not my desire to acquit the Royal Society of all blame, but mitigating circumstances might be urged Joule's experiments no doubt appear conclusive to us, but the very simplicity of his experimental arrangements, and the comparatively few numerical results given, may have raised doubts which were perhaps excusable The heat generated was determined by the rise of temperature of a measured quantity of water in which a coil of uncovered wire was inserted, and no cooling correction was applied Though Joule gave good reasons why these simplifications did not affect the result, such cavalier treatment of the minor sources of error may have shocked the academically-trained mind as showing want of respect for the dignity of the problem It is seldom that referees can rise to the standard of Stokes, who, in reporting on a communication by an eminent man of science possessing great intellectual powers not always assisted by clearness of expression, gave his judgment as follows:—"The first part of the paper I can understand but do not agree with, the second part I cannot understand, but as the results arrived at may be important I recommend that the paper be published in the Philosophical Transactions"

Joule's later work is so intimately connected with the determination of the mechanical equivalent of heat, that the importance of his investigations in other domains is apt to be overlooked The two volumes of his published researches show that he was by no means a specialist, but only those who knew him personally are aware of the extent of his knowledge and broadness of interests ranging over nearly all branches of physics. He was a pupil of Dalton, who had refused to instruct him in chemistry before he had learned the elements of mathematics It was perhaps in recollection of his first teacher of science that Joule once remarked to Balfour Stewart "If I were a young man I would concentrate my attention on atomic weights" When I first became acquainted with Joule, he was a little more than sixty years of age and in full vigour The meetings of the Manchester Literary and Philosophical Society in those days will always remain in the memory of those who were fortunate enough to attend them It was the custom then, and I believe is still, to devote the first half-hour to a discussion on any subject brought forward by some member, spontaneously or at the invitation of the president A regular attendant, Joule was at his best on these occasions He also made his presence felt at the council meetings as a confirmed conservative opposed to all changes His health began to fail about 1882, but in November 1885 he dined at my house to meet the late Lord Rayleigh, who had come to Manchester on purpose to make his acquaintance "I believe I have done a few little things but nothing to make a fuss about," he said, shortly before his mental powers began to fail

After Joule's death, I was asked by his family to examine his apparatus and instruments—mostly constructed by his own hands—and I was fortunate to rescue his historical thermometers, which were lying covered with dust in an old stable attached to his residence I was thus enabled to determine the difference between the scale value of the thermometer used by Joule and that of the standard of the Bureau international des Poids et Mesures. It appeared in the investigation that the glass of Joule's thermometers is more suitable to its purpose than the glass afterwards employed in England The depression of the zero after being raised to a definite temperature is much smaller and more nearly approaches that of the hard glass used by French makers. These thermometers were presented by Joule's son to the Manchester Literary and Philosophical Society: most of the remainder of Joule's apparatus is preserved in the Physical Laboratories of the University of Manchester.

Current Topics and Events.

WE are glad to see that noteworthy recognition is accorded to science in the New Year honours list which was issued last week The appointment of Sir James G Frazer and of Sir Ernest Rutherford to the Order of Merit, an order which was "designed as a special distinction for eminent men and women" and is limited to twenty-four members, will give particular pleasure to scientific workers everywhere Included among the honours are also the following — *Knights* Prof John Adams, Professor of Education, University of London, 1902–1922, Prof R H Biffen, Professor of Agricultural Botany, Cambridge University, Mr G R Clarke, Director-General, Posts and Telegraphs, India, Dr Hari Sing Gour, Vice-Chancellor, Delhi University, Mr W B Hardy, Secretary of the Royal Society, Prof F Gowland Hopkins, Professor of Bio-Chemistry, University of Cambridge, Principal J C Irvine, Principal and Vice-Chancellor of the University of St Andrews, Mr F Truby King, Director of the Child Welfare Division of the Department of Health, Dominion of New Zealand, Dr T M Legge, Senior Medical Inspector of Factories, Mr B Longbottom, Chairman, British Electrical and Allied Manufacturers' Association, Maj-Gen R C Macwatt, Director-General, Indian Medical Service, Mr E. W Petter, President, British Engineers' Association, Dr H J Waring, Senior Surgeon, St Bartholomew's Hospital, Vice-President, Royal College of Surgeons, Vice-Chancellor of the University of London, 1922–1924 *C I E* Mr H G Billson, Chief Conservator of Forests, and Member of the Legislative Council, United Provinces, India *D B E* (*Civil Division*) Miss L B Aldrich-Blake, Dean of the London School of Medicine for Women

AMONG the mechanical inventions which revolutionised the cotton industry was the cotton gin of Eli Whitney, whose death took place on January 8, 1825—a hundred years ago The flying shuttle of Kay, the spinning jenny, the water frame and the mule of Hargreaves, Arkwright and Crompton, together with the power loom of Cartwright, increased enormously the rate of spinning and weaving, but the cleaning of the cotton fibre from the seed was still largely done by hand Whitney's great invention was made in 1792, and in about ten years the export of cotton from the United States rose from less than 200,000 pounds to more than 40,000,000 pounds per annum The essential parts of Whitney's machine consisted of a grid on to which the seeds were fed, a revolving wooden cylinder studded with wire teeth which tore the fibre from the seed, and a revolving brush which in turn removed the fibre from the wires One such machine would do the work of 50 men engaged in hand-picking Whitney was born in 1765—the same year as Fulton—and was the son of a farmer of Westboro, Massachusetts He worked as an artisan, made money by teaching, and in 1792 graduated from Yale When about to take up a post as tutor, a chance conversation led to his tackling the problem of cotton cleaning His gin soon came into use and he had to establish his claims by much litigation Later, he founded a factory at New Haven for the manufacture of firearms and was the pioneer among Americans in the modern methods of making large numbers of interchangeable parts He died at New Haven, leaving a part of his fortune to Yale for the purchase of books on physical and mechanical science

THE year 1924 was a year of notable centenaries, but one of scientific interest seems to have been overlooked, namely, that of the establishment of the first physiological laboratory in Europe The man who opened this laboratory in the year 1824 was Johannes Evangelista Purkinje, at that time professor of physiology and pathology at the University of Breslau It has been suggested that it was through Goethe's influence that Purkinje was appointed to this chair, for the author of "Faust" reckoned him as one of his friends, their common interest being in subjective visual phenomena The reception given by the Prussians to the Bohemian Purkinje was far from cordial, but by his amiability and scientific gifts he lived down all opposition The laboratory of 1824 was not housed in any building belonging to the University but in the professor's private dwelling Doubtless the establishment of this first of European physiological laboratories attracted no attention from the contemporary journalists, but when we reflect on the immense benefits which have accrued to medical science from the findings in the laboratories of practical physiology—insulin being one of the latest—all men of science will like to remember that it is just a few days more than one hundred years ago that the academic pursuit of that subject was inaugurated So far as we can gather, the instruction in Purkinje's laboratory was chiefly in histology, a subject which the anatomists willingly allowed the physiologists to teach for the next century It is only now that that portion of the physiologists' burden is being cast, where it belongs, upon the shoulders of the morphologists

A WRITER who signs himself "Poetarum Minimus" enters a plea in the *Scientific Worker* for December for the exercise of poetic expression in scientific fields, and as an example he submits a contribution having for its theme the evolution of stars from "tenuous mists" up to maturity and down to decay Thus,

> A hundred million million years they scatter largesse of their rays
> They spend their substance royally throughout the measure of their days

The verses from which these lines are taken have commendable dignity and sound, and they are reminiscent of the style of Erasmus Darwin, who essayed similarly to express views of the stellar universe current in his time in the sonnet, "Roll on ye stars, exalt in youthful prime" Tennyson surpassed all other poets in the application of scientific truth to poetic purpose, and his astronomical allusions are particularly fine, as, for example, in "This world was once a fluid haze of light," and "Regions of lucid matter, taking form: Brushes of fire, hazy gleams"

Several years ago the geological course of events, from "Nebula to Man," was described in verse in a sumptuous quarto volume by the late Mr. Henry Knipe, and Mr Alfred Noyes has given us his beautiful epic, "The Torch-bearers," which is on a much higher plane Poetry, however, is something more than accurate description in verse form It should, of course, have a certain beauty of sound when spoken, but its main function is the creation of stimulating thoughts which appeal to the human heart rather than to the intellect While, therefore, we may believe that the wonders of modern science furnish rich material upon which poetic imagination may be worthily exercised, we cannot forget that emotion is independent of knowledge, and that, as Coleridge said, science seeks to know and communicate truth—acceptable or not—but the chief purpose of poetry is to give pleasure The difference is aptly expressed by Sir William Watson in one of his epigrams, thus

Science and Art, compeers in glory,
Boast each a haunt divine
"My place is in God's laboratory,"
"And in His garden mine"

A NEW Research Institute for the improvement of crops, at which special attention will be paid to cotton and to the fundamental problems underlying the production of this crop in India, was formally inaugurated at Indore in Central India on November 24 last The foundation of this new Institute has been rendered possible by the provision of a valuable site of 300 acres by the Indore Durbar, by a grant of two lakhs of rupees (about 15,000*l*) for capital expenditure by the Indian Central Cotton Committee, and by an annual contribution of 120,800 rupees a year (a little more than 9000*l*) for current expenses in addition to the income derived from the land at the disposal of the Institute This annual grant has been provided jointly by the Indian Central Cotton Committee and by seven of the Central India States (Indore, Dhar, Jaora, Datia, Rutlam, Dewas Senior Branch, Narsingharh and Sitamau) The control of the Institute has been vested in a governing body of six members with the agent to the Governor-General in Central India as president Three members of the board of governors are nominated by the Indian Central Cotton Committee, one by Indore Durbar, and two by the rest of the contributing States The Director of the Institute will act as agricultural adviser to the States, and will in this way come in direct touch with the Malwa plateau, one of the most important cotton tracts in India

THE experimental area which will be at the disposal of the new Research Institute, has been leased by the Indore Durbar to the Institute for 99 years at a nominal rent of 20*l* a year, it embraces all the types of black cotton soil met with in India, and is very favourably situated for research work on crops It is close to the city of Indore, now rapidly growing in importance as a commercial, manufacturing, and educational centre, and to the cotton mills The maintenance of an up-to-date library on crop-production and the training of post-graduate students, selected by the Indian Central Cotton Committee, will be features of the Institute Mr Albert Howard (formerly Imperial Economic Botanist at the Agricultural Research Institute, Pusa) has been appointed Director of the Institute and agricultural adviser to States in Central India, and Mrs Howard (formerly second Imperial Economic Botanist at Pusa) will be employed as physiological botanist at Indore

ON Tuesday, January 6, Sir Oliver Lodge gave the first of his series of seven fortnightly talks on "The Ether of Space and its Functions," under the auspices of the British Broadcasting Company at 2LO, which was relaid to many stations in the British Isles, and also to the longer wave high-power station 5XX at Chelmsford The first talk was entitled "First Notions about the Ether How Matter is held together, and how we see it" After describing the functions and uses of the ether, Sir Oliver went on to explain that matter was discontinuous, consisting of isolated particles not in contact, and was only held together by cohesive forces existing in the ether He supposed that if we could magnify a piece of matter to an impossible extent, it would have an appearance something like the midnight sky, where the separated pieces of matter are similarly held together or united into systems by the force of gravitation—which also is a function of the ether So that the ether is a great unifying entity, without which there would be no cosmos, but chaos Sir Oliver concluded his first talk thus "You cannot imagine empty space being thrown into vibration, there must be something in space which vibrates, and that 'something' extends to the furthest visible object, and constitutes a unifying and connecting mechanism, through which all our information is obtained . We have as yet very little acquaintance with the universe, sometimes we seem to know a great deal, at other times we realise that we hardly know anything The mystery of it all escapes us, and the possibilities of it are beyond our conception many of them we could not apprehend if they were explained to us, we have not the terms or ideas to understand them Meanwhile we grope along as best we can, and do our daily work with a keen expectation of the future, and he is wisest who denies least of the mystery which surrounds us and the possibilities ahead To assert, requires knowledge, to deny, requires much more knowledge Let us be satisfied with positive knowledge so far as it has been vouchsafed to us, and leave negations to the self-sufficing and the omniscient We can deny the self-contradictory and the absurd, but in the unknown and the mysterious, denials have no legitimate place our business is carefully and cautiously to ascertain what is We are surrounded by infinity, infinities of various kinds, and the wealth of existence is such as to justify a faith in our highest conceptions, a hope in the possibilities which lie before us, and a charity which enables us to do our daily work and to love our fellow men"

GREENWICH weather observations, which give approximately the average conditions over England,

show that 1924 was generally wet and unseasonable The winter months were mostly mild, while the summer months were mostly cool, and all months were wet with the exception of February, March, and August The mean temperature for the year 1924 was 50° 6 F, which is 0° 5 F in excess of the normal The warmest month was July, with the mean temperature 63°, which is 0° 5 below the normal, the coldest month was February, with the mean temperature 37° 3, being 2° 5 below the normal December was 3° 5 warmer than the average, and there were only three nights, December 9-11, with frost in the season June, July, and August were the only months with a temperature of 80° or above, the highest reading being 89° on July 12 The lowest temperature during the year was 21° on February 15 Rain fell on 168 days, yielding a total of 31 inches, which is 7 5 inches more than the average for thirty-five years The wettest month was July with 4 20 inches, which is 2 inches more than the normal The driest month was February with 0 65 inch, and this was followed closely by March with 0 69 inch, the deficiency for the two months combined being 2 inches 1924 is the wettest year since 1903, when the annual measurement was 35 54 inches In the dry year of 1921 the total rainfall at Greenwich was only 12 50 inches, in 1923, a normal year, the measured rain was 23 86 inches Sunshine was generally deficient, the only months with an excess of sunshine being January, March, July, and December Records of temperature and rainfall for London now extend over about the last 200 years, but careful examination of these fails to give any cycle or periodicity which can help in the prognostication of the weather for a coming year or season, 1925 has started with exceptionally wet and boisterous conditions.

ONE of the recommendations made last year by the Departmental Committee on the Fertilisers and Feeding Stuffs Act, 1906 [Cmd 2125], was the appointment of a committee to consider the articles to which revised legislation should apply. This advisory committee, which has power to co-opt, has now been constituted as follows Lord Clinton (chairman), Mr E G Haygarth Brown, Dr Charles Crowther, Mr J Garton, Mr C. W. Higgs, Mr. Arthur Holgate, Mr Thomas Kyle, Mr. Alexander Main, Lieut-Col R L Norrington, Mr J W Pearson, Mr R R Robbins, Sir E J Russell, Mr John Speir, Mr George Stubbs, Dr J F Tocher, Prof. T B. Wood, and Mr H J. Johns, of the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (secretary) According to the terms of reference, the committee is to draw up schedules prescribing the fertilisers and feeding stuffs to which the proposed legislation on the lines of the Report of the Departmental Committee on the Fertilisers and Feeding Stuffs Act, 1906, should apply, and methods of defining and stating the constituents and the "worthless" and "deleterious" commodities are to be considered

AN interesting new departure in tourist travel is the motor tour across the western Sahara to Timbuctoo. Citroën Cars, Limited, the organisers of the tour, have sent us an itinerary of the route The cars leave Colomb-Bechar, the railway head of the Algerian railway, and pass by Igli and Beni-Abbes to Adrar, the centre of the Tuat region Thence they pass by Taouriot and strike almost due south, reaching the Niger at Burem From Burem the traveller can continue in cars to Gao or Niamey, with the alternative of going by motor boat to Kabara and car to Timbuctoo From Colomb-Bechar to Timbuctoo by this route is 1700 miles, and the time occupied is eight days Timbuctoo is thus brought within twelve days of London, and there is a trans-Sahara service twice weekly Modern hotels have been constructed at Colomb-Bechar, Beni-Abbes, Adrar and Timbuctoo, while at other stopping-places the company maintains camps It is of interest to note that this motor service to Timbuctoo has been instituted within a year of the centenary of the first European traveller entering what was then the mysterious city

MR MURRAY MACGREGOR, district geologist, has been appointed assistant director of the Geological Survey in Scotland in succession to Dr Walcot Gibson

IN connexion with the Liverpool Section of the Society of Chemical Industry, Sir Max Muspratt, Bart, will deliver a Hurter Memorial lecture in the chemistry lecture theatre of the University of Liverpool on Friday, January 16, at 8 o'clock, on "Chemistry and Civilisation"

PROF G T. MORGAN, professor of chemistry in the University of Birmingham, has been appointed Superintendent of the new Chemical Research Laboratory of the Department of Scientific and Industrial Research at Teddington Prof Morgan was awarded the Research Medal of the Worshipful Company of Dyers in 1922 for his work on the co-ordination theory of valency in relation to adjective dyeing, and he is the author of numerous original papers in various branches of chemistry published by the Chemical Society, Society of Chemical Industry, and other societies

APPLICATIONS are invited for some junior assistantships at the National Physical Laboratory, Teddington Candidates must possess a good honours degree or equivalent qualification in physics, engineering or electrical engineering, and preferably with some experience in research Application forms can be obtained from the director of the laboratory They must be returned to him by, at latest, January 17.

ACCORDING to the New York correspondent of the *Times*, the trustees of the Metropolitan Museum of Art have announced the gift to that institution by Mr John D Rockefeller, junior, of 16,000 shares in the Standard Oil Company of California These shares are worth approximately 200,000*l*. The gift is made unconditionally, but the donor suggests in his letter to the trustees that it should be added to the endowment fund

ON Tuesday next, January 13, at a quarter past five, Prof A Fowler will begin a course of two lectures at the Royal Institution on the analysis of spectra,

and on Thursday, at the same hour, Mr Julian Huxley will deliver the first of two lectures on the courtship of animals and its biological bearings The Friday evening discourse on January 16 at 9 o'clock will be delivered by Sir William Bragg on the investigation of the properties of thin films by means of X-rays, and on January 23 by Dr A W Crossley, on science and the cotton industry

THE third meeting of the Society for Experimental Biology was held at Cambridge on December 19 and 20, the different sessions being held in the Schools of Zoology and Physiology Members were entertained at lunch in Caius College by Prof J Stanley Gardiner, and a dinner was held in Christ's College The programme included a paper by Prof J Barcroft on "Hæmoglobin as an Example of the Evolution of a Chemical Mechanism," a discussion by Dr H H Dale on "The Nature of the Active Substances in the Posterior Lobe of the Pituitary Gland," and a symposium on "The Rôle of Electrolytes in the Organism," in which Messrs A J Clark, J Gray and J B S Haldane took part A number of other papers of interest were presented Fifteen new members were elected

SIR NAPIER SHAW has published privately a "Kalendar for 1925" arranged in weeks, showing the seasons and the international days for observation of the upper air This is followed by a detailed list of the daily observations of solar and terrestrial radiation made in England during 1924 For each day of the year there is shown the sun's declination, the measurement of solar intensity at Kew Observatory between 11h 30m and 12h 30m, the observations at South Kensington and Rothamsted of the maximum intensity of radiation from sun and sky and of the total radiation during the day upon a horizontal surface, and measurements of incoming and outgoing long-wave radiation made at Benson on cloudless evenings These observations are given in weeks with the unusual but convenient arrangement of giving on each page two weeks which are separated by an interval of six months The addition and subtraction of observations separated by six months gives the even and odd harmonics of the radiation curve separately The Kalendar thus contains in readily accessible form much information of great value to meteorologists and others interested in solar and terrestrial radiation

Two books of ethnological interest are announced for publication by Messrs Seeley, Service and Co, Ltd, namely, "The Menace of Colour," by Prof J W Gregory, dealing with many of the interracial problems of the day, and pointing out the dangers of the rising tide of colour and how they may be met or avoided, and "Vanishing Tribes of Kenya," by Major Orde Browne, Senior Commissioner of Tanganyika, a record of the habits and customs of the tribes inhabiting the slopes of Mount Kenya

Our Astronomical Column.

THE ABSORPTION OF LIGHT IN OPEN STAR CLUSTERS —Dr P ten Bruggencate, in the *Zeitschrift fur Physik*, October 31, describes an investigation of the colour indices of stars of the open clusters N G C 1647, of Præsepe and of the Hyades, and deduces that these clusters consist almost entirely of dwarf stars, as is to be expected on the assumption that they have developed from globular clusters and are of great age Colour-brightness diagrams were prepared, in which the catalogued stars were plotted, and, with certain assumptions as to the value of the parallax, graphs corresponding to the stars of the general stellar system, as determined at the Mount Wilson Observatory, and described by Seares, were drawn on the same diagrams It was found that in neither case did the stars of the cluster agree with the graph This was also true of the colour-brightness diagram of the Pleiades, which has already been described by the author

In the case of N G C 1647, an analysis of the diagram leads to the conclusion that the abnormal distribution of the stars in it is due partly to the assumed parallax being too large, and partly to absorption due to extensions of the dark nebulosity in Taurus, which lies between the cluster and the earth In the case of the two other clusters and of the Pleiades, there is general absorption due to nebulosity inside the clusters The Pleiades form a younger cluster than the others, which contains a number of A and F stars, and the nebulosity in it is bright and connected with the bright stars, being formed from material recently given off by these stars, which are in an unstable state of development In Præsepe and the Hyades the clusters are older, and the internal nebulosity has become dark.

No nebulosity is found in globular clusters which are relatively young, the stars not having reached the stage of development mentioned above, the first sign of instability in these clusters is the occurrence of variable stars These and the super-giants develop to O type stars and planetary nebulæ, and it is to be expected that the remains of these nebulæ will be found in old star groups or open clusters

OBSERVATIONS OF ALGOL VARIABLES —An important paper by Col E E Markwick (B A A Journal, vol 35, No 2) contains discussions and light curves of six Algol variables from observations by himself and other members of the Variable Star Section They are a good example of the useful results that can be obtained in this field by careful and long-continued visual estimations of magnitude The curves for three of the stars show secondary minima U Ophiuchi, loss of light at secondary minimum 0 2 mag, RW Tauri 0 2 mag, Z Vulpeculæ 0 1 mag They did not succeed in detecting the secondary minimum of Algol, but the curve of principal minimum is shown in great detail. The total number of observations used is 2630 they begin in 1906 for most of the stars, 1899 for Y Cygni The period found for Algol is 2 867265 days, which is 3 9 sec shorter than that given by Chandler The range of the observations used is 5336 days or 14 6 years The commencement and end of the principal eclipse are more rounded than those on Stebbins's curve The effect is to make the total duration of eclipse 14 09 hours, which is longer than is generally given, but Col Markwick defends his curve on theoretical grounds

Research Items.

HUMAN REMAINS FROM ANCIENT GOLD MINES IN RHODESIA —In view of the conflicting interpretations of archæological evidence in Rhodesia, any human remains to which any degree of antiquity can be attributed are likely to be of importance for the early racial history of that area Considerable interest therefore attaches to a report by Sir Arthur Keith on two skeletons from ancient gold mines which appears in Vol xxiii of the Proceedings of the Rhodesian Scientific Association The Que-que skeleton was found 4½ ft below the surface in a filled-in working It is represented by numerous fragments, all weathered, partly dissolved and fallen into pieces They are only lightly mineralised, yet have the appearance of having been buried for a considerable time, possibly a thousand years or more Such characters as can be recognised indicate a young female of about 18 years of age, of an estimated height of 5 ft 1 in, and belonging to the negro race The second specimen, from Belingwe, is a pure negro type, male, between 20 and 30 years of age The skull is small, length 182 mm, breadth 124 mm, index 68, cranial capacity 1220 cc A remarkable feature is the projection of the alveolar bone 9 mm beyond the nasal spine and its wide simian nasal grooves The skull is mineralised to a certain extent, and somewhat more ancient than the Gwanda woman (described in the Proceedings of the Rhodesian Scientific Association, Vol xxi) whose stature has now been calculated as 4 ft 9 in. These measurements are comparable with those of two skeletons of ancient man from Rhodesia described by Dr F C Shrubsall in *Man* in 1909 Thus all the remains we have from ancient ruins or mines in Rhodesia are of the Negro or Bantu type, and show no trace of Arab, Egyptian, Bushman, or Hottentot strain.

PALÆOLITHIC INDUSTRY IN NORTHERN CHINA —T. de Chadin and F Licent (Bull Geol Soc China, iii. 1924, p 45) record the discovery of palæolithic floors at three different places in Inner Mongolia The floors are found at the base of the Loess and in the Loess itself, and the associated mammals include rhinoceros, hyena, gazelle, antelope, horse, bison, elephas, etc The implements are made of quartzite, psammite and silicified limestone, and appear to be of Mousterian or early Aurignacian type In the same regions in which palæolithic implements are found in the Loess, evidence of neolithic man is shown by the presence on the surface of the earth of polished axes, arrow-heads, knives and borers

VITALITY OF JELLY-FISH —It is a remarkable fact that many of the lower animals are able to live for a long time without food, maintaining themselves during the period of starvation at the expense of their own tissues and not merely by means of reserve stores of fat or other substances. A very interesting case of this kind is described by Messrs de Beer and Huxley in the *Quarterly Journal of Microscopical Science* (vol 68, part 3). They found that the common jelly-fish, *Aurelia aurita*, can be kept alive without food in laboratory aquaria for as much as thirty-eight days, during which time they undergo a progressive decrease in size, accompanied by loss of morphological and histological differentiation The bell begins to shrink first, the oral arms later. Tentacles and thread-cells disappear and the gastro-vascular cavity closes up, the final result being a very small, shapeless mass The bell continues its pulsations until an advanced stage of the process has been reached It will come as a surprise to many naturalists that such a delicate organism as Aurelia can remain alive for so long under such unfavourable conditions

THE BORING MECHANISM OF TEREDO —The manner in which the ship-worm bores into timber has been a matter of conjecture and dispute among naturalists for at least two centuries Some have supposed the soft fleshy foot to be capable of rubbing away the fibres of the wood, perhaps with the help of a solvent or softening secretion, others have regarded the valves of the shell, with their file-like rows of teeth, as the instruments of boring It has been reserved for Mr R C Miller (Univ California Publ Zool, xxvi, No 4, pp 41-80, 4 pls) to give what appears to be a conclusive answer to the question After a detailed account of the structure of the shell, the foot and the muscles connected with them, he discusses the possible methods of boring that have been suggested He points out that the foot is covered with columnar epithelium, becoming glandular and ciliated near the edges and obviously unfitted for abrasive action The possibility that some solvent enzyme may be secreted is not altogether excluded, although an analysis of shavings from the inside of the burrow showed no significant difference in composition from sound portions of the same block The presence of "tool-marks"—scratches corresponding with the serrations of the shell—on the inside of the burrow, which has often been denied, is admirably demonstrated by a series of photographs Finally, by laying bare the inner end of the burrow and sealing a cover-glass over the opening, the author succeeded in watching the Teredo at work It was found that the movements of the animal in the burrow were effected chiefly by means of the suctorial and surprisingly mobile foot Boring was seen to be accomplished by rhythmical movements of the valves of the shell, which were "held in position by the combined action of the foot attached to one wall of the burrow and the dorsal fold of the mantle pushing against the opposite wall"

THE CHANGING COLOUR OF THE MINNOW —The minnow (*Leuciscus phoxinus* sive *Phoxinus laevis*) is one of those species of fish in which the male in the breeding season assumes brighter colours. Mr Leo Abolin's communications (Beeinflussung des Fischfarbwechsels durch Chemikalien, Pt I Infundin- und Adrenalinwirkung der Melano- und Xanthophoren der Elritze, Pt II Annahme mannlicher Erythrophorenfarbung durch das infundinisierte Weibchen der Elritze, Nos 119 and 120 *Mitteilungen aus der Biologischen Versuchsanstalt in Wien, Zool Abt*, under the direction of H Przibram) give a most interesting explanation of the mechanism by which this is brought about. From the first paper we learn that the colour of the fish is mainly due to black and yellow pigments contained in cells termed melanophores and xanthophores respectively These cells are situated in two layers of the skin, a deeper and a more superficial Injections of minute doses of weak solutions of adrenalin contract the melanophores and cause the fish to assume a pale yellow colour, the effect passes off in about two hours Injections of similar doses of post-pituitary extract cause expansion of the melanophores of the under layer and of all the xanthophores The grey colour of the fish becomes greenish and the belly, which is normally silver, becomes golden yellow If the fish is blinded the injection causes intense expansion of the melanophores in the sensitive regions of the body (the lips, gill-covers and the sub-branchial region of the head), but the xanthophores do not expand The same

result is obtained if the sympathetic system is destroyed, only in this case both layers of melanophores are expanded and the xanthophores are contracted, in fish which lie on a dark surface the same result follows under normal conditions From the second paper it appears that in the superficial layer of the skin on the lips, the bases of the fins, and on the belly, there is contained a certain amount of red pigment embedded in cells termed erythrophores When the male becomes ripe, these erythrophores become widely expanded, as do the melanophores and xanthophores This same result can be obtained in ripe females and in small unripe males and females in which no trace of red is externally visible, by the injection of somewhat strong doses of post-pituitary extract (one-tenth per cent) It is therefore obvious that the bodies of males and females, so far as pigment is concerned, have the same structure, and that the secondary sexual characters of the male are due to the action of the distinctively male hormone on this common groundwork

YEASTS, FATS, AND ALCOHOL FROM SEAWEED — We have recently received from Prof Nadson, of the Principal Botanical Garden, Leningrad, a short typewritten communication from which it appears that the possibility of the commercial utilisation of seaweeds is at the present moment occupying the attention of Russian chemists The paper in question is entitled "Seaweeds as a Source of obtaining Yeast, Fat and Alcohol," and contains a brief summary of the results obtained by Prof Nadson working in collaboration with Messrs A G Konokotina and G K Burgvitz The authors claim to have succeeded in growing both bakers' and brewers' yeasts (of the type of *Saccharomyces cerevisiæ* I, Saatz, Frohberg, etc) upon autoclave extracts of *Laminaria saccharina*, and from the results obtained they conclude that it should be profitable to produce compressed bakers' yeast and dry "Nahrhefe" of high protein content in this way They have, moreover, apparently succeeded in producing an abundant growth of "fat" yeast, *Endomyces vernalis* Ludw, upon minced and boiled *Laminaria saccharina*, cultures kept at 6-8° C for sixteen days are stated to have produced a yield of 6 22 per cent of fat upon the medium as compared with a normal content of only 0 3 to 1 per cent of fat in the untreated weed On the strength of these results, the authors recommend the use of seaweed as a substrate for the production of fat for technical purposes The authors further state that they have produced alcohol from a decoction of *Laminaria saccharina* prepared by soaking 5 per cent of finely ground material in water for 12-14 hours and sterilising at 110°, on this they have grown three different kinds of yeast (1) Strains of *Saccharomyces ellipsoideus*, Saatz and Frohberg, (2) yeasts isolated from fermenting sugar-beets—*Saccharomyces betæ*, and (3) torula isolated from the surface of the living *Laminaria saccharina* of Murman No data are given as to the yields of alcohol obtained, but it is claimed that the distillation of alcohol from algæ gives several valuable by-products The information supplied in this communication is scarcely sufficient to carry very much conviction The object of the publication may be best stated by quoting the authors' own words "We are giving the results obtained by us in order once more to direct attention to the seaweeds of Russia as one of her natural riches awaiting their utilisation"

CRETACEOUS FAUNA AND FLORA OF SHANTUNG — An extensive series of freshwater deposits formed in a continental basin in Shantung is described by H C Tan (Bull Geol. Survey of China, No 5, pt 2, 1923), and is believed to be mainly of Cretaceous age Numerous fossils have been found in the deposits, and furnish interesting evidence of the plants and animals which, during a long period of time, lived on land or in fresh water They include dinosaurs, fishes, freshwater molluscs such as Unio, Leptesthes, Cyrena, Bithinia and Valvata, insects belonging to the orders Orthoptera, Blattoidea, Coleoptera, Odonata, Lepidoptera, Diptera, etc The plants are mainly conifers and cycads Descriptions and figures of some of the molluscs and insects are given by A W Grabau

SOMERSET OIL-SHALES —Messrs H G Shatwell, A W Nash, and J I Graham recently communicated an account of the Somersetshire oil-shales to the Institution of Petroleum Technologists These shales outcrop for about ten miles along the coast in the vicinity of Blue Anchor, and extend inland for a distance of one to three miles They form part of an argillaceous and calcareous group of sediments which have been assigned to Lower Lias and Rhætic horizons, and their mode of occurrence is in two basins lying on either side of the Devonian Quantock Hills, the larger basin (Lilstock Basin) being situated on the east, the smaller (Doniford Basin) on the west Bituminous shales of Lower Lias age have long been known from the opposite South Wales coast, and the authors conclude that the Somerset shales are a continuation of these The Somerset shales occur in beds varying from 1 to 20 feet in thickness, those of South Wales being much thinner, 6 inches to 5 feet Proximate analyses of the Somerset shales show that they have an average specific gravity of 2 4, from 70 to 73 per cent of ash, 3 5 per cent of moisture, 23 to 28 per cent of volatile matter (less water), 1 70 to 4 52 per cent of sulphur, and 13 to 17 per cent of carbon dioxide The specific gravity is higher than the Scottish oil-shale, which averages 2 0, while the high carbonate content is unusual Results of assays and steam distillations carried out by the authors show that the yield of oil from one ton of shale is about half that of the average yield from the same quantity of Scottish shale, the total amount obtained from the Somerset shales varied from 5·00 gallons to 10·4 gallons, ammonium sulphate from 4 to 6 lb, and gas from 1200 to 1900 cubic feet per ton The crude shale oil has an average specific gravity of 0 939 and sulphur content up to 3 12 per cent, it is dark brown in colour and has a less sweet odour than that distilled from Scottish shale On fractionation, naphtha (specific gravity 0 807 to 0 852), kerosene (0 888 to 0 925), and heavy distillate (0 973) are obtained, distillate above 300° C failed to yield more than a trace of paraffin wax From the above details it will be gathered that the Somerset oil-shales, notwithstanding the comparatively low sulphur content of the oil obtained from them, do not inspire confidence from a commercial point of view

RAINFALL IN MYSORE —The Meteorological Department of the Mysore Government has issued a Report on Rainfall Registration for 1923, prepared under the supervision of Mr C Seshachar, the Meteorological Reporter There were 226 stations gauging rainfall during the year. The greatest rainfall on any one day was 17 90 inches at Agumbi in the Shamoga District on August 7, the heaviest record in 1922 was 22 16 inches at the same station In the Kadur District the heaviest fall in 24 hours was 16 85 inches at Byrapur Estate on July 24, and in the Hassan District, at Marnhalli toll-gate, the fall in 24 hours on August 14 was 11 43 inches In no other District did the fall in 24 hours amount to 5 inches July was the wettest month on record since 1893, the year in which the

Meteorological Department was organised, the monsoon was unusually active in the western parts of the State. A monthly total of 202 inches was recorded at Byrapur Coffee Estate against a normal of 106 inches. The south-west monsoon period, June to September, was generally wet, the total rain over the State being 26 per cent above the normal. The north-east monsoon period, October to December, was the driest on record since 1893. The deficiency varied from 66 per cent in the Mysore District to 89 per cent in the Chitaldrug District. The seasonal aggregate for the State was 1·95 inches against a normal of 8·04 inches, which is 76 per cent in defect of the normal. The largest annual total for a single station was 393·64 inches at Agumbi in the Shamoga District, and the smallest was 4·36 inches at Dharmapur in the Chitaldrug District. Rainfall maps are given, which help much to a complete understanding of the work.

A SHUNTED GRASSOT FLUXMETER.—A Grassot fluxmeter may be described as an over-damped moving-coil ballistic galvanometer having practically no controlling force. This instrument is of great value for measuring magnetic flux. Gisbert Kapp, in his book on "The Principles of Electrical Engineering," suggests the possibility of increasing the range of the instrument by using a shunt, but he gives neither the theory of how it would work nor the formulæ that would have to be used with it. In April 1924 Masamiti Sase read a paper to the Physico-Mathematical Society of Japan in which he gives the complete theory of the multiplier, and gives experimental results confirming it. In the instrument he used, the highest permissible value of the shunt was about 8 ohms, which was about one-third of the resistance of the fluxmeter. He shows that it is desirable to use a shunt of manganin wire having the highest allowable resistance. His results prove conclusively that the particular Grassot fluxmeter with which he experimented could be used with a shunt of 8 ohms even when the highest accuracy is required. This greatly increases the range of the instrument.

THE EVIDENCE OF THE PROOF PLANE.—Mr. J. Clark, writing from Kewanna, Manitoba, directs attention to a method of dealing with observations made with the proof plane. When such a plane, without electrical charge, is introduced into the electrostatic field surrounding one or more conductors, one at least of which is charged, it will have, at each point in space, a definite potential V_p, depending on the external charges and the equal charges of opposite signs induced upon it. This potential Mr. Clark calls the potential of the free charge of the proof plane. If, then, the plane is brought up to a large insulated conductor, the total charge of which is zero, without actually making contact with it, the potential V_p will, in general, differ from the uniform potential V_c of the conductor, being greater than V_c on one side of the conductor and less on the other. If now the plane is made to touch the conductor, electricity will flow from the plane to the conductor in the first position, and from the conductor to the plane in the second, so that when the plane is removed from the field, and brought to an electroscope, it will be found to have a negative charge in the first case and a positive charge in the second. It is not always possible to regard the proof plane as temporarily forming a part of the surface which is being tested, since this is often curved, and the method suggested will often prove valuable.

A NEW DIAMAGNETIC PHENOMENON IN GASES.—An investigation of the diamagnetism of hydrogen, nitrogen and carbon dioxide, at different pressures, is described by Dr. A. Glaser in the *Annalen der Physik* for October. A rod of diamagnetic lead glass was suspended inside the experimental tube containing the gas, by a 2-5μ quartz thread attached to a torsion head. Thin threads of paramagnetic cobalt glass were melted on to the rod, so that the whole became slightly paramagnetic. The tube was surrounded by a water jacket by means of which the temperature was kept constant to within 0·01° C. In each observation the torsion head was twisted to bring the light spot to zero. As the pressure was diminished the susceptibility at first diminished in proportion, but in each of the gases this ceased to be the case at a pressure which depended on the nature of the gas and the intensity of the field. Thereafter the rate of diminution of susceptibility with pressure diminished greatly for some time, and in the end, at low pressures, the susceptibility was three times as great as it would have been if the original rate of diminution had been maintained throughout. It is suggested that, at low pressures, the distance between the molecules is such that there is time between collisions for them to become oriented with respect to the field. At higher pressures the collisions are constantly destroying any tendency to orientation which may be produced, so that all the molecules are practically unoriented.

A NEW LEAD ACCUMULATOR.—In the *C. R. Acad. Sci. Paris*, November 24, M. C. Féry describes a lead accumulator which does not sulphate, even if discharged and left uncharged for two years, at the end of which time it can be recharged in the ordinary manner. The author has previously shown that the true reaction taking place in the Planté cell is given by the reversible equation,

$$Pb_2 + H_2SO_4 + Pb_2O_5 = Pb_2SO_4 + 2PbO_2 + H_2O,$$

and that $PbSO_4$ is only formed accidentally when the cell becomes "sulphated." Pb_2O_5 is a black peroxide, and Pb_2SO_4 is greyish black in colour. The spontaneous discharge of the Planté cell is due to the combined action of the electrolyte and of oxygen on the negative plate, according to the equation

$$Pb_2 + H_2SO_4 + O = Pb_2SO_4 + H_2O,$$

and this action may develop into

$$Pb_2SO_4 + H_2SO_4 + O = 2PbSO_4 + H_2O$$

if the cell is left undischarged too long. To avoid this, the author places the negative plate at the bottom of a deep glass jar, and separates it from the positive, and from the air, by a porous material containing the electrolyte. A figure in the original paper shows the cell as it appears when partly discharged, with a layer of black plumbous sulphate on the upper surface of the negative plate. A cell left without recharge for twenty-six months only lost 66 per cent. of its original charge, the loss in the first month being 4 per cent., 83 per cent. of the original charge remaining after four months, while an ordinary cell would have lost the whole of its charge in this time.

ERRATUM.—In NATURE of December 20, p. 900, in a paragraph on the "Cytology of Cotton," referring to the work of Mr. H. J. Denham, it is suggested that the reason for the appearance of Mr. Denham's papers in the Journal of the Textile Institute as well as in the *Annals of Botany* is the importance of the work to the cotton-growing industry of the British Empire. We learn that the work referred to was carried out at the laboratories of the British Cotton Industry Research Association, and permission to publish it in the *Annals of Botany* was given on the understanding that, in common with all papers from the Association's laboratories, it would be published in the Journal of the Textile Institute.

The Japanese Earthquake of 1923.

MR K SUDA, of the Imperial Marine Observatory at Kobe, has recently issued a detailed and interesting report on the great Japanese earthquake[1] It is based on an examination of all the seismograms obtained at Japanese observatories and on an exploration of the central tract from September 10 to October 12 The following is an abstract, not of the whole memoir, but of those portions which have not been fully treated in earlier papers[2]

It is not often that isochronal lines (the coseismal lines of Mallet) can be drawn for any earthquake The large number of earthquake observatories in Japan and the radio time-service have enabled Mr Suda to give a series of such lines, certainly the most accurate of any yet attempted They are drawn for every ten seconds, except towards the north-east From the epicentre to a distance of 200 km the curves are extremely irregular Beyond this distance they become portions of nearly concentric circles, and the distance between successive curves increases with the distance from the origin The curves in the north-east of Japan are packed more closely together than in the south-west The irregularity of the curves is due partly to geological conditions, partly to the form of the focus

On the same map are shown the initial directions of the shock These are not always directed towards or from the epicentre, small deviations being experienced at several places, due chiefly perhaps to the geological structure of the country The initial motions are condensational (or from the origin) at nearly all the observatories to the south-west of the line from Matsumoto to Kofu Between this line and that from Niigata to Fukushima (that is, in the region including the central zone) condensational and rarefactional movements are mixed together To the north-east of the latter line the initial motions are again, with few exceptions, condensational The complexity in the intermediate region may be connected with the nature of the displacement that caused the earthquake The directions of initial motion are usually normal to the isochronic lines Smoothing off the local variations in these lines, the space-time curve is drawn. It cuts the time-axis at a point corresponding to 11 h 58 m 26 s , the time of occurrence at the epicentre considered as a point The velocity of the primary waves near the epicentre was 5 5 km per sec , that of the large waves was constant and about 3 59 km per sec

One more result obtained from the study of the seismograms may be referred to The angle of emergence at Kumagaya was 21°, and at Choshi 13 5°. At Mera the epicentral distance is 46 km , and the focal distance (as determined by the duration of the preliminary tremor) 70 km , at Tokyo these distances are 82 km and 98 km The focal depths given by these four observations are about 50, 35, 54, and 55 km , the average being 48 km

Mr Suda adds some interesting details about the changes of level along the coast of Sagami Bay Since the earthquake, the land has shown a tendency to return to its original level For example, at Misaki (near the end of the Miura peninsula) the elevation on September 1 was about 760 cm and the sea-bed between it and a small island in front was laid bare On September 5 the land here began to sink, at first at the rate of nearly 60 cm a day, then more slowly, until on September 26 the uplift was only about 140 cm Similarly, at Tateyama, at the end of the Bo-so peninsula, the uplift on September 1 was 220 cm. Later in the same month it was reduced to 140 cm The first upheaval and the subsequent sinking were both most marked at the ends of these peninsulas. There is also evidence that, at both points, the land had been slowly sinking for many years before the earthquake At Shitaura, near the end of the Miura peninsula, the land had sunk about 2 metres during the preceding sixty years, and some of the farms near the shore had become covered by the sea After the earthquake the land was restored to its former level The remarkable changes of level in the floor of Sagami Bay have been referred to in NATURE (vol 113, pp 473-474) The first soundings were made soon after the earthquake They have since been repeated with great care, and a comparison of the two maps reveals no great differences The *tsunami*, or seismic sea waves, were comparatively low The greatest height attained was 11 metres at Atami, where 155 houses were washed away and about 60 persons were killed. Mr Suda attributes the small height of the waves in part to the upheaval of the land round Sagami Bay

One of the most interesting chapters in the memoir is that on after-shocks Omori had found empirically that the decline in frequency of after-shocks follows a hyperbolic law The theoretical investigation by Prof S Kusakabe shows that the decline takes place according to a logarithmic law, of which Omori's law is a particular case, and that the frequency-curve approaches or deviates from the hyperbolic form according as the time during which the stresses causing the earthquake act is long or short As the curves for different observatories are nearly hyperbolic, it follows that the great earthquake was tectonic, and not volcanic, in origin Mr Suda, however, points out a remarkable feature in all the frequency-curves, whatever the distance from the epicentre From the first to the third days the curve is hyperbolic , and, after the fourth day, again hyperbolic but with a lessened value of the constant For example, at Kumagaya, the frequency-curve is at first represented by the equation $xy = 327$, but after the fourth day by the equation $xy = 242$ Mr Suda infers that the stresses that caused the earthquake began to operate again after three or four days, and that, in consequence, the frequency of after-shocks was distinctly less after this time He suggests that these districts will probably be visited periodically by great earthquakes until the stresses causing them are changed

The after-shocks are divided by Mr Suda into two classes, which he calls the Sagami-Sakawa family and the Bo-so family, the former occurring in an area to the west of a north-south line passing just to the east of Oshima, and the latter in an area on the east side After-shocks of the Bo-so family were usually stronger than the others and had a longer vibration-period. The greatest of the Bo-so series was that on September 2 at 11 h 47 m , which was nearly as strong as the great earthquake The epicentre lay off Katsuura, on the Pacific side of the Bo-so peninsula, and the first displacement within the focal region occurred in a vertical plane, for the initial motion at every observatory near the epicentre was directed outwards Mr. Suda points out an interesting relation between the frequency of the after-shocks generally and the atmospheric pressure, the rate of pressure-change and the pressure gradient The frequency is slight or great according as these conditions are the same as, or contrary to, those which prevailed on the day of the earthquake

The theoretical portions of Mr. Suda's memoir, interesting as they are, must be passed over more

[1] Mem Imp Marine Obs, Kobe, Japan, vol 1, 1924, pp 137-239, tables 1-49, and 46 plates
[2] NATURE, vol 113, pp 254, 473-474, vol 114, pp 70, 291, 484

rapidly. He considers that there were two epicentral zones, one directed north-north-east in the central part of Sagami Bay, the other intersecting it and directed north-west The former coincides with the great region of subsidence in the bay, and this subsidence produced the condensational initial motion around the epicentre Beneath the second epicentral zone, he thinks, there was a horizontal sliding of a layer of the crust towards the south-west, which would produce condensational motion on the south-west side and rarefactional motion on the north-east side The vertical displacement beneath the first zone being the more important, the condensational initial motion prevailed at some distance from the origin Among the secondary causes of the earthquake Mr Suda includes the typhoon which was passing over the northern part of the epicentral region at the instant when the earthquake occurred C. D.

Italian Theses on Chemistry and Physiology.

THE twenty-sixth volume of reports, recently issued by the Cagnola Scientific Foundation, covers the period 1917–1923 and deals with the essays on various scientific subjects submitted for adjudication to committees appointed by the Royal Lombardy Institute of Science and Literature The subjects vary widely in character, but are all of medical or chemical interest In a few instances only have the theses presented been deemed worthy of reward, and of the successful theses, four only are printed *in extenso* in the present volume

In "The Chemio-therapy of the Spirilli," which extends to over 160 pages and is accompanied by many plates, diagrams, etc, Prof Giorgio Castelli gives, in addition to a succinct account of previous knowledge of this subject, the results of his own numerous experiments, which lead to various important conclusions. The slight increase in the efficacy of the curative agents determined by prolonged contact of the latter with the air during the manipulation is insufficient to compensate for the dangerous increase often observed in the toxicity Oral administration of the arsenobenzenes is not to be recommended, and the use of dimethylaminotetraminoarsenobenzene, proposed by Giemsa, is not only less effective than that of salvarsan or neosalvarsan, but is also followed by more frequent and more ready relapse Increased toxicity is also against the employment of compounds obtained by the introduction of amino and other nitrogenous groupings, sulphur, etc, into the molecule of arsenobenzene In some cases augmented therapeutic efficacy is attained with compounds of salvarsan with silver or copper salts, but here too the frequency of undesirable after-effects militates against the application of such compounds on a large scale

Prof Aldo Perroncito, in a short contribution on the derivation of blood platelets, demonstrates the possibility of the formation of new platelets independently of the elements of all other tissues of the organism In blood drawn from the jugular vein of the cat or dog, and treated with sodium citrate to render it non-coagulable, and then with pyrodin solution, the number of the platelets becomes doubled or, in some instances, even quintupled after the blood has been kept at 38° C for about an hour Exclusion of the intervention of either the corpuscles or the plasma leads to the conclusion that the platelets are capable of reproducing other elements with similar morphological characters

In his memoir entitled "Catalytic and Enzymic Phenomena," occupying 130 pages and including a very useful bibliography, Prof Ugo Pratolongo develops a novel interpretation of recent results arising from modern mechanico-static theories of chemical phenomena He has succeeded in distinguishing in chemical kinetic equations the terms depending on piezometric actions and on medial actions from terms proper to the mechanism of the reaction The application of this principle to well-known accelerating reactions shows that some of these are definitely catalytic in nature, inasmuch as a change in the mechanism of the chemical reaction, and hence in the critical energy relative to the reaction, is involved, others are of medial character, and others again—heterogeneous catalyses—possibly depend on variations in the active concentration of the reagents induced by the catalyst. The experimental results show that, in the decomposition of hydrogen peroxide, the critical energy assumes values depending strictly on the metal functioning as catalyst and independent both of its method of preparation or state of subdivision and also of the presence of activating or inactivating agents Thermal inactivation of a catalyst consists of partial destruction of the catalyst, the remaining fraction retaining its activity unaltered

Under the title "Interchange of Hæmoglobin in Physiological and Pathological Conditions," Dr Enrico Greppi discusses the different factors operative in the continual destruction (hæmolysis) and re-formation (hæmoglobinogenesis) of the blood-pigment

Astronomical Observations at Greenwich and the Cape.

THE first impression on seeing the annual volume for 1921 of "Greenwich Observations"[1] is its thinness in comparison with the volumes of two or three decades ago It appears to be the least bulky in the last hundred years. This is due to a reduction accomplished during Sir Frank Dyson's tenure of office by the suppression of much of the detail of the observations, but enough is still given to show the data on which the tabulated observations depend

The results are given concisely and orderly, and they represent an immense amount of routine work which is carried on from year to year at Greenwich, a work never in the limelight but, on its astronomical side at least, the basis for the discussion of all the problems of fundamental astronomy

The observations with the Transit Circle take up the first section, and show the state of adjustment of the instrument from day to day, and then give the observations of right ascension and declination of the sun, moon, and planets, together with the observed errors of the tabular place as given in the Nautical Almanac More than 17,000 observations were made in connexion with the Transit Circle in the course of the year The observations of the moon have been combined with the extra-meridian ones taken with the Altazimuth, and give the error both of the Nautical Almanac (Hansen's tables with Newcomb's corrections), and Delaunay (Connaissance des temps,

[1] Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1921

Radau's tables) It is of interest to note that the latter corrections are much the smaller

The observed errors of the wireless time signals received from Paris, Nauen, and Annapolis are shown in Table IV (p A 16) The range of error, from about 0 2 sec early to 0 4 sec. late for each of the three observatories, is rather large when the installations for determining and keeping time at the observatories concerned are considered The observations, however, have not been corrected for errors in the sending It is not stated to which series of morning signals the Paris observations refer, and it would be of value to any one discussing these results to know whether the beginning, middle, or end of the signal was referred to the local clock beat

The next section deals with the measures of the photographs of the sun taken at Greenwich, the Cape, Kodaikanal, and Dehra Dun Thanks to this co-operation, photographs were available for each day of the year There is a pronounced decline in the mean daily area of spots, corrected for foreshortening, from 1052 (1919), 618 (1920), to 420 (1921) Similar figures for the faculæ are 1729 (1919), 1219 (1920), to 739 (1921), the unit being the millionth of the sun's visible hemisphere The last section gives the usual details concerning the magnetical and meteorological observations These form about one-third of the whole volume Plates show the magnetic disturbances for three consecutive days, May 13, 14, and 15

In one respect the title, " Greenwich Observations, 1921," does the book less than justice Except in the annual report at the end of the volume, there is, for example, no mention of the work done with the Thompson Equatorial, with which more than 1000 parallax plates were taken, and almost as many measured There is no question that the national observatory at Greenwich continues to maintain its high standard of duty and performance, though one may require to read between the lines to prove it

The Cape portion of the Astrographic Chart and Catalogue extends from declination $-40°$ to $-52°$ The volume of the catalogue now issued [2] is the eighth of this series to appear The previous members, numbers i -vii , give the measures in the seven zones from $-41°$ to $-47°$, the first appearing in 1913, and the last in 1923

The present volume was delayed in printing, apparently by the War, for the introduction was signed by the late Mr S S Hough in 1916 It contains the measures of the rectangular co-ordinates of all the stars shown on the plates having their centre on the declination circle $-50°$

The introduction gives a short description of the telescope, the method of measurement of the plates, the process followed to guard against errors in the measuring, and the further checking of the results by the intercomparison of overlapping plates It is evident that great care has been taken to eliminate errors

The plates were exposed during the years 1902–1908 and measured with two exceptions between November 1907 and September 1908 The catalogue gives the measures of the x and y co-ordinates to 0 001, an estimation of the diameter of the image, together with the identification by number and magnitude of the star in the Cape Photographic Durchmusterung, if it occurs in that catalogue No attempt is here made to convert these estimates of stellar diameter into a standard scale of magnitude

The catalogue proper consists of 465 pages, with a total of 79,105 stars, or a distribution for the first 12 hours of R.A of 32,504 and for the last 12 hours of 46,601

[2] Catalogue of Rectangular Co-ordinates and Diameters of Star Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope Zone $-50°$

Annual Meeting of the Geographical Association.

THE annual meeting of the Geographical Association was held at the London School of Economics on the first three days of January The gathering was remarkable for an extraordinarily valuable series of papers of high scientific worth, for a broadcast message by Prof J L Myers, the president, and for a continuation of the plan of inviting a distinguished continental thinker, in this case Dr A Sommerfelt, of Oslo, to speak

In his presidential address, Prof Myers dealt with the historical method in ethnology and with cogent argument and gentle banter criticised the conclusions of some investigators, especially Mr Perry, who, applying the hypothesis of long distance diffusion of culture, announced as discoveries speculations which recalled extreme conclusions of Max Muller on the Aryan Race or those of the Anglo-Israelites on the lost tribes

Among the other papers two stood out as remarkable One was entitled on the programme " Life among the Hill Tribes of Algeria " It cannot be described satisfactorily either as a description illustrated by films or as films with appropriate comments, for the first of the noteworthy points just was that it was a coherent whole in the sense that the words and music of a good song are coherent The kinema was in fact seen at its best as an educational instrument of the highest class It is not easy to make it so, but that it can be done is evident The second point is that what was done was worth doing The films were thoroughly scientific, extremely human, entirely free from anything meretricious and yet extraordinarily interesting They are the property of Mr J A Haeseler, who is collecting a scientific library of such films, and they had been taken with the help of Capt Hilton-Simpson, who gave the address They showed the actual life of the people basket-making, shoemaking (with platted grass), making of wooden door-locks with an adze strikingly like a bronze age tool, quern-making and corn grinding, ploughing, skinning a goat and the processes by which the skin is turned into a water-bottle, and bread-making, but perhaps the most fascinating of the pictures were those showing the fundamental arts of textile and pottery making Spinning was exhibited as carried on by two or three of the simplest possible methods, one even without the aid of a spindle, while two types of simple looms, and the entire operation of weaving from the making of the warp and setting up of the loom to the final process of inserting the woof, was shown with wonderful clearness So also clay was obtained from a pit, freed from stones, and a pot gradually built up before one's eyes without—and this is the remarkable fact—the aid of the potter's wheel The ornamenting of the pot, the firing, the fire being lit by a boy, and the glazing of the still hot vessels were equally clearly shown

The performance—it is difficult to find a satisfactory word for the combined appeal to eye and ear—gave an insight not only into the geography of another land, but also into conditions of a long past time very thinly veiled by later growths and accretions We have said that the kinema was seen at its best This was because it was used for what it is best fitted. It was used to show things as they happened,

dynamically, not statically We might perhaps qualify our statement and say "almost at its best" It would have been better, though impracticable, to show several of the films again Even when one knew what to look for, it was quite impossible to follow all the details of what was done Further, it was obvious that while for exhibiting processes the film is the superior, yet for still life and for analysis the slide has still the advantage

The other paper was by Mr C E P Brooks and was entitled "The Climatic History of the Fiord Countries" Climatology is still in its infancy, and this is one of the few papers which deal with climatic, as distinct from meteorological, problems without becoming unintelligible amid a maze of statistics Mr Brooks traced out the succession of climates during and since the Ice Age, if indeed we are out of the Ice Age He suggested that the Daun stadium should be dated round about 1800 B C rather than 5000 B C, and estimated the temperature of the Norwegian coast at 5000 B C to have been 4° higher than at present His most striking suggestion related to the causes of these climatic changes He associated them with variations in the ice conditions in the Arctic Ocean Analysis of these conditions by Kerner Marilaun and himself has shown that the Arctic floating ice-cap must either have its present extent or the whole ocean must be free of ice, no intermediate stage being stable He related the voyages of the Norsemen, who in their voyages to the south of Greenland mention storms but never ice, and the great Asiatic migrations, to an open period in which the Arctic was unglaciated, and concluded, "In the twelfth century the glacial stage recurred and has apparently persisted to the present day" So we are still in the Ice Age!

Periodicals in Canadian Libraries.[1]

THE need for co-operative library catalogues of scientific periodicals has long been felt in many countries, and various projects have been undertaken to supply the deficiency The work before us is an attempt to provide for those specially interested in scientific periodicals, and consists of a list of such material available in Canadian libraries, together with bibliographical information Journals are arranged under their latest form of title, and publications of academies under the name of the society or institution In our opinion, this method of listing the publications of academies does not facilitate their ready identification Under the words "Kaiserlich" and "Koniglich" there are quite a number of entries, although events of recent years have caused these adjectives to be dropped or replaced As an example, the Koniglich-Preussische Akademie der Wissenschaften is now known as the Preussische Akademie, though this fact cannot be ascertained from the present work Had publications of this character been listed under the first word of their title—in this case Sitzungsberichte—consultation would have been simplified

It is to be regretted that a number of Canadian libraries, whilst those responsible realised the importance of the work, were unable to include their possessions in this list The reasons given were that periodicals were not catalogued or that the staff at their disposal was inadequate It is obvious that full advantage cannot be taken of the resources of Canadian libraries if a proportion of them are compelled to neglect the preservation and cataloguing of serials Further, Canadian science will be under a distinct handicap until steps are taken to provide the libraries with adequate competent assistance

Despite the difficulties confronting them, the compilers have produced a work which should prove of considerable aid to scientific workers in the Dominion, and they are to be congratulated upon the completion of a volume which bears evidence of much care and painstaking labour Due credit should also be given to the Canadian Department of Scientific and Industrial Research, the material co-operation of which enabled the early publication of the volume

F W CLIFFORD

[1] A Catalogue of Scientific Periodicals in Canadian Libraries Prepared by Dr Gerhard R Lomer and Margaret S Mackay Pp xx+255. (Montreal McGill University, 1924) n p

University and Educational Intelligence

ABERDEEN —The Fullerton Research Scholarship in natural science has been awarded to Miss Elizabeth T Geddes

GLASGOW —The King has been pleased to approve the appointment of Mr James Montagu Frank Drummond to the regius chair of botany in the University, vacant by the retirement of Prof F O. Bower Mr Drummond took first-class honours in the Natural Sciences Tripos at Cambridge in 1904, and gained the Frank Smart Studentship for research in botany at Gonville and Caius College He became lecturer in botany at Armstrong College, Newcastle-upon-Tyne, and in 1909–1921 was lecturer in plant physiology in the botany department of the University of Glasgow Since 1921 he has been Director of the Scottish Plant Research at Corstorphine, Edinburgh During the War he served in Palestine, Egypt, and France, acting as brigade education officer His published works refer chiefly to plant physiology, but include a series of papers on the "Botany of the Palestine Campaign" communicated to the Linnean Society

LONDON —The lectures which were to have been given early this month by the late Prof J. I Hunter at University College on "The Anatomy and Physiology of the Sympathetic Innervation of the Striated Muscle" will be delivered by Prof G. Elliot Smith on January 19, 26, and February 2 at 5 o'clock

The degree of Ph D in Science has been conferred on Mr. W Jevons (Imperial College—Royal College of Science) for a thesis entitled "Spectroscopic Investigations in connexion with the Active Modification of Nitrogen" and other papers

NOTICE is given by the Imperial College of Science and Technology, South Kensington, of the alteration in the date of the Entrance Scholarship Examination, which in 1925 will begin on April 21 Eighteen Scholarships, value 62*l* 10*s* each, are offered, six being tenable at the Royal College of Science, six at the Royal School of Mines, and six at the City and Guilds (Engineering) College, for admission at the beginning of the session, namely, the first Tuesday in October Prospectuses and full particulars may be obtained on application to the Registrar, Imperial College, South Kensington, S W 7

APPLICATIONS are invited by Yale University for two Theresa Seessel Research Fellowships for the promotion of original research in biological studies, each yielding 300*l* Preference will be given to candidates who have already obtained their doctorate, and have demonstrated by their work fitness to carry on

successfully original research of a high order The holder must reside in New Haven during the college year, ranging from October to June Applications should be made to the Dean of the Graduate School, New Haven, Conn, U S A, before May 1 next, and should be accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate expects to investigate

THE Royal Technical College, Glasgow, directs attention in its report for 1923–24 to the part taken by it for many years in the further education of adults The evening classes of last session were attended by 2587 adult students of ages ranging from twenty-one to seventy-five and, in addition, 546 enrolments were received for the "Elder" lectures on astronomy by Prof George Forbes on "The Old Astronomy and the New," and by the Rev E Bruce Kirk on "Stars in their Associations." The College maintained also its press campaign for informing the public of the important part taken by chemistry in the life and industry of the country, and numerous papers of a popular character were published by members of the staff on such subjects as the utilisation of waste, chemistry and wireless, etc

FROM the University of Leeds we have received a copy of the Council's annual report for 1923–24, which was issued on the eve of the Jubilee and "Coming of Age" celebrations of December 15-20 In it the Council announces, after summarising the serious and numerous present deficiencies in accommodation and equipment and in the provision for the social and athletic life of the University, that action is being taken to meet the most pressing requirements and to make the Jubilee year a starting-point for another period of progress That they are able to do so is due in large measure to increased local aid Grants from local authorities during the past year amounted to 30,000*l*, not counting the fees, amounting to 4500*l*, remitted to students as a condition of such grants The other chief sources of revenue were endowments, donations, and subscriptions, 21,000*l*, parliamentary grants-in-aid, 58,000*l*, and fees for tuition, examinations, graduation, Students' Union, etc, 60,000*l*

THE December number of *The University Bulletin*, issued by the Association of University Teachers, contains an address by the president of the association, Prof Alexander Mair, on the significance of this organisation as marking a distinct phase in the evolution of the university system in Great Britain Among the many *éclaircissements* produced by the War were, Prof Mair says, the revelation to English people that in the universities they had a *national* asset, and a clearer awareness on the part of the universities themselves of their function and destiny A "get-together" spirit took the place of particularism, and one of the indications of this was the appearance of the Association of University Teachers At present about 75 per cent of all the teachers in the university institutions of England and Wales belong to its 25 branches, although "Oxford and Cambridge are still hesitant, and their absence makes the one (an important) gap in an otherwise continuous front" In referring to the spirit of co-operation as between universities and the recognition of their value to the nation as post-War phenomena, Prof Mair seems to have overlooked the fact that the first Congress of Universities of the Empire took place, and the Universities Bureau of the British Empire was constituted in 1912.

Early Science at the Royal Society.

January 10, 1662/3 Mr Howard mentioned a way of roasting in a very short time, with basting the meat with flames of lard poured upon it Dr Wilkins, that of boiling and stewing meat with lamps Mr Hoskyns, that of roasting many pieces of meat with a fiery globe of plated iron standing in the middle Sir Cyril Wyche, that of keeping water and other things warm in a double pot, separated by an interstice

January 11, 1671/2. Mr Isaac Newton was elected. [Newton had written earlier "I am very sensible of the honour done me by the Bishop of Sarum in proposing me candidate, and which I hope will be further conferred upon me by my election into the society, and, if so, I shall endeavour to testify my gratitude, by communicating what my poor and solitary endeavours can effect towards the promoting philosophical design"]

1664/5 Sir Robert Moray mentioned, that the King had made an experiment of cold, with three glasses filled with sweet water, used for washing, one glass bigger than the other, taken out of a trunk by the King's barber, and freezing, after they had a very little while been opened, first at the top, and then with shootings of ice to the bottom, and so congealing together

January 13, 1663/4. The president acquainting the council, that Mr Hooke had discovered to himself, Sir Robert Moray, and Dr Wilkins, an invention, which might prove useful to England, and to the world, and that he had a good opinion thereof, but that it was necessary, that some experiments should be made for farther certainty, before it was made public which would require some charges not so fit to be put upon the inventor, it was ordered, that the President, Sir Robert Moray, and Dr Wilkins have power to employ any sum under ten pounds of the society's money for the said purpose

1669/70. Mr Oldenburg produced a manuscript sent and addressed to the president by Mr Flamstead of Derby, giving an account of some of the more notable celestial phenomena of the year 1670 to be conspicuous in the English horizon, among which was an eclipse of the sun visible in England, April 9, but omitted by all other astronomers. The society declared that this was a very useful labour for the improvements of astronomy, and that therefore the author should receive their thanks by the secretary.

January 15, 1661/2. Prince Rupert sent the society a description in High Dutch, of the method of making good gun-powder, which Mr Oldenburg was desired to translate, and Sir Robert Moray to return their thanks to his highness

1673/4. It being moved that Dr Daniel Cox having made many observations and experiments concerning the nature and figures of all sorts of salts, might be desired to impart them to the society, he was desired accordingly, and promised, that he would do so, after he had viewed and examined such salts by such a microscope, as had been approved of for its goodness by the Society and a microscope being brought by Mr Cock to be examined, the trial of it was referred to a fitter time, it being then candle-light

January 16, 1667/8. Mr Oldenburg mentioned that he had received advice from Paris, that the person formerly said to have undertaken the translation of the "History of the Royal Society" into French, had not yet begun it, and was willing to forbear, upon notice sent him, that there was one in London, who would perform it. And Dr de Molin being the person, who had undertaken that work in England, and now present, was desired by the Society to proceed in what he had begun with all possible care and diligence

Societies and Academies.

LONDON

Aristotelian Society, December 15.—L. J. Russell: Science and philosophy. Scientific investigation makes use of hypotheses, but something more is needed in the search for truth. The inquirer goes to Nature with demands which his own nature enjoins on him. Demands like hypotheses are anticipations; they say more than Nature tells, but they go beyond hypotheses, for they challenge Nature. Some demands are logical, some æsthetic, some metaphysical. Only legitimate demands can be satisfied, and we can only know what demands are legitimate by explicating the universe in detail by their help. There cannot be a view which is true in philosophy and in the end unworkable in science, or a view which is true in science and untrue in philosophy.

CAMBRIDGE

Philosophical Society, December 8.—C. T. R. Wilson and G. I. Taylor: The bursting of soap-bubbles in a uniform electric field. Measurements were made of the electric field necessary to burst a soap-bubble attached to a metal plate. The half-bubble correctly represents half of a complete bubble immersed in a uniform electric field. The instability is shown by photographs to take the form of a thin thread of fluid which is drawn off from the top of the bubble. The product (electric force) × (square root of radius) is constant at the bursting point. The maximum diameter of water-drop which can exist without bursting in a uniform electric field of 30,000 volts per cm. is 0.4 mm.—E. A. Milne: Dissociative equilibrium in an external field of force. The conditions of thermodynamic equilibrium in a gravitational field of heterogeneous substances capable of undergoing reversible chemical reactions, which were formulated by Willard Gibbs, are extended to include the case in which the products or reactants are associated with electric charges and may be subject to an external electric field. Application is made to the high-temperature ionisation of gases in stellar atmospheres.—T. M. Cherry: (a) Some examples of trajectories defined by differential equations of a generalised dynamical type; (b) Integrals developable about a singular point of a Hamiltonian system of differential equations. Part II.—J. Brill: Note on the Lorentz group.—E. H. Neville: Note on the harmonic conic.—R. Hargreaves: Thermodynamics and quantum theory.

DUBLIN

Royal Dublin Society, December 16.—H. H. Jeffcott: The theory of variation of flow in pipe lines with surge chambers consequent on variation of load on hydraulic turbines operated therefrom. The surge chamber, used with long pipe lines, acts as a supplementary reservoir near the turbines, so that the demand for increased discharge consequent on increase of load can be promptly met. This avoids the delay occasioned by the inertia of the great mass of water in the pipe, which requires some time for its acceleration, and also serves to relieve the pipes from water hammer consequent on the partial or complete closing of the turbine gates on reduction of load. The surge oscillations set up in the pipe line and surge chamber must not be allowed to persist for so long as to disturb the operation of the turbines unduly, and to this end a damping arrangement is often introduced. Equations are obtained for the motion of the water in the general case corresponding to any given law of opening or closing of the turbine gates, and approximate solutions are given.—Rev. H. C. Browne: The influence of the Fitzgerald contraction upon distance measurements and clock times. A real, absolutely existing Fitzgerald contraction underlies the relativity contractions indicated by the Lorentz formulæ, and the entire symmetry and equivalence of all systems in uniform motion of translation depend upon this real contraction resulting from the absolute undiscoverable movement of each system through space. The constancy of the observed velocity of light for each system, and the establishment of a consistent "timing" of events, common to all observers throughout a system, also depend upon this real contraction. Since all experimentally determined velocities, including that of light, result from some expression of the form $c' = l'/t'$, where l' is a fixed measured length and t' an observed interval of time, the value of c' will vary inversely with the value of t', but the product $c't'$ will have the fixed value l' independently of the rate of time movement. The same is true for $v't'$, and the ratio v'/c' will also be independent of the rate of time movement, provided that this latter is constant. In this way all expressions containing a problematic absolute value for c' and v' can be eliminated, and the concrete observed values $c't'$, $v't'$ can be substituted; *i.e.* velocities and times can be written down in the specialised form in which they must enter into any equation containing space co-ordinates. The form of the Lorentz transformations changes, but the mathematical contents remain identical.

PARIS.

Academy of Sciences, December 1.—Charles Moureu, Charles Dufraisse, and Marius Badoche: Auto-oxidation and antioxygen-action (XII.). Researches on the active auto-oxidisable form of acrolein.—Auguste Bépal: The fifth international conference of pure and applied chemistry, held at Copenhagen, June 16 to July 1, 1924.—Georges Claude was elected a member of the division of the applications of science to industry, in succession to the late H. de Chardonnet.—Mordouhay-Boltovskoy: The impossibility of an algebraical relation between π and e.—Bertrand Gambier: The polygons of Poncelet generalised.—Maurice Gevrey: The integration of the equation of dynamical tides.—E. Huguenard, A. Magnan, and A. Planiol: The measurement of the aerodynamical stresses supported by the wings of an aeroplane.—Jean Boccardi: Averaging by tenths of a year in variations of latitude. The usual method of taking the means of the values of the latitude, ϕ, by tenths of a year, has inconveniences and may lead to erroneous conclusions.—J. Prédhumeau: A new apparatus for the automatic construction of contoured maps by photographic restitution. An apparatus, named the "stereotopometer," is described, capable of giving maps with contour lines from photographs taken at the level of the ground. The method is purely optical, and this is claimed as better than the optico-mechanical methods previously described. The accuracy of the results is independent of distortion due to the photographic objectives.—Nicolas Perrakis: The thermodynamical interpretation of ionisation potential. The atom is transformed and equilibrium is maintained, due to the expulsion of an electron, the departure of which absorbs a quantity of entropy equal to $C_i T$, where C_i is the thermo-electronic constant, 4.07×10^{-27} cal./deg.—A. Dufour: The distortion of an electromagnetic perturbation propagated along an insulated conducting line.—G. Bruhat and M. Pauthenier: The theory of electrostriction in insulating liquids.—Michel Doloukhanoff: The automatic regulation of the power of an electrical

installation In an electrical installation composed of n machines of different powers, the number of combinations is $2^n - 1$, each working at or near its maximum capacity, and consequently with maximum efficiency Thus four dynamos of 100, 200, 400, 800 kilowatts will permit of the range 100 to 1500 kilowatts, in 100 kilowatt steps and with a favourable power factor The application of the same principle for other electrical machinery is outlined —— **Rateau** Remarks on the preceding communication The use of approximate geometric series —E **Carrière** and **Arnaud** Determination of the boiling-point curves and dew points of mixtures of hydrochloric acid and water under a pressure of 760 mm The experimental results are given in tabular and graphical form —J **Heyrovsky** Applications of the method of electrolysis with the mercury drop cathode —M N **Goswami** The direct hydrogenation and dehydrogenation of acenaphthene Sabatier and Senderens showed that their method of hydrogenation with nickel at 210°-250° C converted acenaphthene into tetrahydroacenaphthene, $C_{10}H_{10}\left\langle\begin{matrix}CH_2\\ | \\ CH_2\end{matrix}\right.$ If the temperature of the nickel is lower, 150° C, a mixture of tetrahydro- and decahydroacenaphthene is obtained, separable by fractional distillation If the vapours of acenaphthene, without hydrogen, are passed over nickel at 300° C, a good yield of acenaphthylene, $C_{10}H_6\left\langle\begin{matrix}CH\\ \| \\ CH\end{matrix}\right.$, is obtained —P **Lebeau**: The presence of ethane in fire-damp from the Mines de Gagnières. The presence of about 2 per cent of ethane together with traces of unsaturated hydrocarbons (0 04 per cent.) in this fire-damp was proved The method followed was liquefaction at −215° C, with subsequent fractional distillation.—Jacques de **Lapparent** The phenomena of sedimentation in the Cretaceous and Eocene strata in the Western Pyrenees.—I **Thoulet** The liquid clouds of the ocean —Ph **Wehrle** and A **Viaut** The notion of interference in dynamic meteorology —L **Petitjean** The displacement of fronts of discontinuity —P **Martens**: The cycle of the somatic chromosome in *Listera ovata* —K. **Kvapil** and A **Němec** The relation between the "absolute air capacity" and the degree of acidity of forest soils. The absolute air capacity, defined as the volume of the pores of the soil which, after saturating the soil with water, remain filled with air, is a physical property of fundamental importance as regards fertility The acidity, P_H, and the absolute air capacity have been measured for fifteen samples of forest soil, of which five were taken from forests containing conifers only, five from forests planted with deciduous trees only, and the remainder from regions planted with both —E **Rabaté** The action of dilute sulphuric acid upon fields of cereals Dilute sulphuric acid (4-10 per cent), sprayed at a suitable stage of growth on growing cereals, has been proved to fertilise the soil, destroy weeds, check the action of certain parasites, and give an increased yield of 200 kgm to 300 kgm of seed per hectare at a cost of less than 100 francs —A **Policard** The phenomena of fluorescence determined in the tissues by Wood's light (radiations of wave-length 3650 Å) Application to the histology of the human ovary Sections which appear uniformly white under ordinary daylight illumination, show differences of colour under the Wood light, indicating differences of constitution A detailed account is given of the application of this new histological method to the examination of the human ovary —P de **Beauchamp** The transmission of variation in rotifers of the genus Brachionus —Mlle France **Gueylard** The influence of life in salt water on the development of the spleen in fishes In fishes capable of living in fresh and in salt water, a prolonged sojourn in the latter leads to a reduced development of the spleen —Léon **Blum**, Maurice **Delaville**, and Van **Caulaert** Modifications of the blood resulting from anaphylactic shock The method of ultrafiltration has been applied to the blood After anaphylactic shock, there is a marked increase in the proportion of calcium passing through the ultra-filter This effect is constant, and indicates a change in the protein colloid

CAPE TOWN

Royal Society of South Africa, October 15 —J S **Thomas** and W F **Barker** The partial pressures of water and sulphuric acid vapours over concentrated solutions of sulphuric acid at high temperatures (Preliminary note) The method adopted was the dynamical one of bubbling a carefully measured volume of air through acid at the required temperature and accurately determining the total quantity of vapour removed and also the amount of sulphuric acid contained in this vapour Only one concentration, 95 per cent, has been completely worked out Extrapolation of the total pressure curve to 760 mm gave the value 304° for the boiling-point of the acid, this compares favourably with the experimentally determined value 303°-307° —E **Newbery** On the application of the cathode ray oscillograph to the study of electrode phenomena (Preliminary note) The cathode ray oscillograph, supplemented with a thermionic valve, has been applied to the study of the single potential curves of a series of metallic cathodes in dilute sulphuric acid during make and break of the current through the cell Evidence of the existence of transfer resistance was obtained The direct method of measuring overvoltage cannot be relied upon in any circumstances, the commutator method gives true values only when extrapolation to infinite speed is carried out All the phenomena observed are readily explainable on the hydride theory of overvoltage —D F. **Morrison** The pharmacological action of *Acokanthera spectabilis*. The main action is on the heart, and is similar to that of digitalis The hour dose for frogs, and the minimal lethal doses for cats, rabbits, guinea-pigs, and rats show that the plant, which is indigenous to South Africa, possesses a high degree of toxicity There is a relative immunity on the part of the rabbit The plant contains glucosides.—M. R **Levyns** Note on some Peninsula plants. New or interesting plants from the Cape Peninsula.

Official Publications Received.

Proceedings of the Royal Irish Academy Vol 36, Section A, No. 8: Corresponding Points on the Curve of Intersection of Two Quadrics. By Dr A C. O'Sullivan Pp 131-154 2s Vol 37, Section B, Nos 1, 2, 3. The Colorimetric Estimation of Thiocyanates and Cyanates, by Dr Kenneth Claude Bailey and Mrs Dorothy F H Bailey, The Reaction between Ferric Chloride and Potassium Thiocyanate, by Dr Kenneth Claude Bailey, Freezing-points of Solutions containing Ferric Chloride and Potassium Thiocyanate, by Dr Kenneth Claude Bailey and J D Kidd Pp 18 1s. (Dublin Hodges, Figgis and Co, London: Williams and Norgate, Ltd)

Memoirs of the Department of Agriculture in India Vol 13, No 4, Botanical Series The 'Mahali' Disease of Coconuts in Malabar By S. Sundararaman and T S Ramakrishnan Pp 87-97 (Calcutta Thacker, Spink and Co London W Thacker and Co) 12 annas, 1s

Transactions and Proceedings of the New Zealand Institute Vol 55 Pp xviii+884+71 plates (Wellington, N Z W A G Skinner; London Wheldon and Wesley, Ltd)

Conseil Permanent International pour l'Exploration de la Mer Rapports et Procès-verbaux des Réunions. Vol 34, Procès-verbaux (Septembre 1924) Pp 60. (Copenhague Andr Fred Host et fils)

Memoirs of the Indian Museum Vol 5 Fauna of the Chilka Lake. No 13 On a species of Sub-fossil Solitary Coral from the Chilka Lake. By Prof George Matthai Pp 897-903 (Calcutta Zoological Survey of India) 1 rupee

Proceedings of the Geologists' Association Edited by A K Wells Vol 35, Part 4, December Pp 265-430 (London Edward Stanford, Ltd) 5s.

Union of South Africa Department of Agriculture (Division of Chemistry Series No 31) Science Bulletin No. 30 An Investigation into some Physical and Chemical Changes occurring in Grapes during Ripening By P R v d R Copeman Pp 38 (Division of Chemistry Series No 33) Science Bulletin No 32 The Composition of ripe Wine Grapes from the Government Viticultural Station, Paarl By G Frater Pp 30 (Division of Chemistry Series No 34) Some Methods of detecting Irregularities in the Composition of South African Wines By F Fevrier Pp 17 (Pretoria Government Printing and Stationery Office) 3d each

Department of the Interior United States Geological Survey Water-Supply Paper 514 Surface Water Supply of the United States, 1919-1920 Part 12 North Pacific Slope Drainage Basins C Lower Columbia River Basin and Pacific Slope Drainage Basins in Oregon Pp v+204+2 plates 25 cents Bulletin 756 Oil and Gas Fields of the Lost Soldier-Ferris District, Wyoming By A E Fath and G F Moulton Pp iv+57+8 plates. 20 cents Bulletin 750-C Observations on the rich Silver Ores of Aspen, Colorado By Edson S Bastin Pp ii+41-62 n p Professional Paper 92 The Middle and Upper Eocene Floras of South-eastern North America By Edward Wilber Berry Pp x+206+65 plates. 1 dollar (Washington Government Printing Office)

Department of Scientific and Industrial Research Report of the Food Investigation Board for the Year 1923 Pp iv+77+4 plates+14 charts (London: H M Stationery Office) 3s net.

Proceedings of the Yorkshire Geological Society New Series, Vol 20, Part 1, December Edited by H C Versey and Herbert E Wroot Pp 154+v+12 plates (Leeds)

Committee of the Privy Council for Medical Research Report of the Medical Research Council for the Year 1923-1924. Pp 142 (London H M Stationery Office) 3s 6d net

Diary of Societies.

SATURDAY, JANUARY 10

BRITISH ECOLOGICAL SOCIETY (Annual Meeting) (at University College), at 10 A M —Prof. F E Weiss Plant Structure and Environment (Presidential Address) —Prof Oliver Blakeney "Far Point."—Prof Fritch The Algæ of Swiftly Flowing Streams —Prof Yapp. De position of Frost on Leaves

INSTITUTE OF METALS (London Section) (at Institute of Marine Engineers), at 7.30 —Dr R H Greaves. Extensometers

MONDAY, JANUARY 12.

ROYAL IRISH ACADEMY, at 4 15

ROYAL SOCIETY OF EDINBURGH, at 4 30 —E L Gill: The Permian Fish Dorypterus.—E A Baker The Blackening of the Photographic Plate at Low Densities —Dr E L Ince The Modes of Vibration of a Stretched Membrane with a particular Law of Density

INSTITUTE OF TRANSPORT (Yorkshire Local Section) (at Town Hall, Leeds), at 5 30 —J B Hamilton Inaugural Address

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Merchant Venturers' Technical College), at 6 —W B Woodhouse Presidential Address

INSTITUTION OF AUTOMOBILE ENGINEERS (at Chamber of Commerce, Birmingham), at 7 —Dr. S S Pickles The General Manufacture of Rubber (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 — W. Day and others Discussion on Telephonic Development in Great Britain and in the United States.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-on-Tyne), at 7 15

INSTITUTE OF METALS (Scottish Section) (at 39 Elmbank Crescent, Glasgow), at 7 30 —Open Discussion

SURVEYORS' INSTITUTION, at 8

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Major R W G Hingston Animal Life at High Altitudes

INSTITUTE OF BREWING (at Engineers' Club) —J Stewart The Season's Barleys

TUESDAY, JANUARY 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15 —Prof. A Fowler The Analysis of Spectra (1)

INSTITUTION OF MECHANICAL ENGINEERS (South Wales Branch) (at Swansea), at 6 —A A Fordham Steel Construction as applied to Steel Works and Mill Buildings.

INSTITUTION OF CIVIL ENGINEERS, at 6 —Prof A. H Gibson. The Investigation of the Surge-Tank Problem by Model Experiments — F. Heywood The Flow of Water in Pipes and Channels.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 — Dr S. S Pickles The General Manufacture of Rubber (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7 —W. B Woodhouse Presidential Address

MANCHESTER METALLURGICAL SOCIETY (at College of Technology, Manchester), at 7 —F C H Lantsberry: Tool Steels

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A S Watson Portraiture of Men.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates Meeting) (at Broadgate Café, Coventry), at 7 15 —A. E. Barrett: Piston Rings

SOCIETY OF CHEMICAL INDUSTRY (Birmingham Section) (at University), at 7 15 —H. L Heathcote The Testing of Resistance to Tearing — D. F. Twiss and F. Thomas A Comparative Study of some Vulcanisation Accelerators

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-on-Tyne), at 7 30 —A R Page Brazing

QUEKETT MICROSCOPICAL CLUB, at 7 30 —S R Wycherley The Mounting of Chemicals for the Polariscope

ROYAL SOCIETY OF MEDICINE (Psychiatry, Neurology, Disease in Children, and Epidemiology Sections), at 8 30 —Dr P C P Cloake and Dr F C Shrubsall (Psychiatry), Prof E Bramwell (Neurology), Prof A Hall (Disease in Children), Dr McNalty and Dr Parsons (Epidemiology), and others Discussion on The Mental Sequelæ of Encephalitis Lethargica

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Section)

WEDNESDAY, JANUARY 14

ROYAL SOCIETY OF ARTS, at 3 —Lt-Col G M Richardson Dogs in Peace (Dr Mann Juvenile Lectures)

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5 30 —Dr V Coates Clinical Types of so called Infective Arthritis

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6 —S Ward Some Notes on Short Wave Reception

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 7 —H J Deane and others Discussion on The Use and Abuse of Reinforced Concrete

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —H W Taylor Three Wire Direct Current Distribution Networks Some Comparisons in Cost and Operation

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-on Tyne), at 7 — J Calderwood Propeller Design

ENTOMOLOGICAL SOCIETY OF LONDON, at 8 —Annual Meeting

THURSDAY, JANUARY 15

ROYAL SOCIETY, at 4 30 —Sir Charles Sherrington and E. G T Liddell Further Observations on Myotatic Reflexes —Prof A. V Hill, C N H Long, and H Lupton Muscular Exercise, Lactic Acid, and the Supply and Utilisation of Oxygen Parts I, II, and III —Prof A P Chattock The Physics of Incubation —H M Carleton Growth, Phagocytosis, and other Phenomena in Tissue Cultures of Fœtal and Adult Lung — J F Fulton (a) The Influence of Tension upon the Electrical Responses of Muscle to Repetitive Stimuli, (b) Some Observations upon the Electrical Responses and Shape of the Isometric Twitch of Skeletal Muscle, (c) The Relation between the Durations of the Isometric Twitch and of the After action of Tetanus

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15 —J S Huxley. The Courtship of Animals and its Biological Bearings (1)

INSTITUTION OF MINING AND METALLURGY (at Geological Society of London), at 5 30

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates Meeting) (at Watergate House, Adelphi), at 7 30 —A E L. Collins Steam Vehicles for Road Transport

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30 —A Steavenson A Peep into Sir William Herschel's Workshop

CHEMICAL SOCIETY, at 8 —E E Turner and A B Sheppard 6 Chlorophenoxarsine —G A R Kon and R P Linstead The Chemistry of the Three-Carbon System Part III $\alpha\beta$-$\beta\gamma$ Change in Unsaturated Acids, Part IV A Case of Retarded Mobility

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W), at 8 15 —Lt-Col A T Gage and Lt-Col. Clayton Lane. The Alkaloids of Cinchona and Malaria

INSTITUTION OF RUBBER INDUSTRY (at 16 St Mary's Parsonage, Manchester) —J Adamson History of the Rubber Industry in Manchester

FRIDAY, JANUARY 16

ROYAL SANITARY INSTITUTE (at Town Hall, Newcastle-on-Tyne), at 4 — Dr A F G Spinks, H H Evers, and others Discussion on Maternity and Child Welfare Practice.

ROYAL DUBLIN SOCIETY, at 4 30

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.

INSTITUTE OF METALS (Swansea Section) (at Swansea University College), at 7 15 —Prof C A Edwards Alloys and their Properties

JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—Major A M Taylor The Hexaphase System and the Compensated 3-Phase System for 150,000 Volts Transmission with Records of Test.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cathays Park, Cardiff), at 7 30 —T Lewis Chemical Constituents of Ductless Glands

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group jointly with the London Section) (at Royal Society of Arts), at 8 —T W Stainer Hutchins, Dr C H Lander, and others Discussion on The Low Temperature Treatment of Bituminous Materials.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 8 —Sir Max Muspratt, Bart. Chemistry and Civilisation (Hurter Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg: The Investigation of the Properties of Thin Films by means of X-Rays.

PUBLIC LECTURES.

WEDNESDAY, JANUARY 14

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —B J Fletcher The Principles of Design (Introductory Lecture).

ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE (Physiology Department, 6 Giltspur Street, E C 1), at 5 —Prof C Lovatt Evans The Physiology of Plain Muscle (Succeeding Lectures on January 21, 28, February 4.)

KING'S COLLEGE, at 5 30 —Prof A P Newton. The World of the Middle Age.

THURSDAY, JANUARY 15

UNIVERSITY COLLEGE, at 2.30 —Miss Margaret A. Murray Egyptian History (Introductory Lecture).

SATURDAY, JANUARY 17, 1925.

CONTENTS.

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Research in Agriculture.

ALTHOUGH the Development Commissioners are not themselves directly responsible for agricultural education and research during the last fourteen years, the manner in which the funds subject to the jurisdiction of the Commissioners have been portioned out has exercised a dominating influence on both the quality and quantity of scientific information that has been recently acquired, and on the nature of the organisation by which it has been sought to render this information of immediate assistance to the farmer. If the fourteenth Report of the Development Commissioners (H M S O, 4*s* net) is read in conjunction with the first and later reports, it will be noted that the Commissioners have favoured and adhered to a more or less definite policy from the outset. They realised that one of the primary needs was to assist in the training of men competent to conduct research, and then to accelerate research on the fundamental problems underlying agricultural practice The body of scientific men at present employed in connexion with agricultural science is to-day vastly greater than it was fourteen years ago, and it is probably not too much to say that the average training which these men have received, and also the attainments and qualifications of the average man, are decidedly better.

It has been the policy of the Commissioners to add to the volume of research, chiefly by assisting in the initiation and maintenance of Research Institutes and Experimental Stations, and there are now about twenty such stations in Great Britain dealing with fundamental problems. It is interesting in passing to note that the necessity of having more than one institution to deal with certain problems which have specially local application has now been realised and acted upon, thus England, Scotland, and Wales has each a Plant Breeding Station aided by grants from the Development Fund, while the needs of horticulture, for example, are recognised at more than one institution.

The Report before us affords ample evidence of the quality and quantity of the research in progress at these institutions. It is beyond the scope of the present article to attempt to review this work It is necessary, however, to lay emphasis on its fundamental character, the vast majority of the scientific papers for which the staffs of the institutions have been responsible dealing with difficult problems approached in an exhaustive manner and by purely scientific methods. There can, in short, be not the least doubt that the policy of the Development Commissioners has been successful to a marked degree in two highly important directions. To-day we have, comparatively speaking, a large, and in the main a well-qualified, body of agricultural scientific workers, and a vast mass of accurate scientific

data of great potential value to the farmer and to the nation. No reasonable criticism can be levelled against the Commissioners for the manner in which the funds have been apportioned in relation to solving the problems of the various branches of the industry, although to some it may appear that horticulture has been treated more generously than would at first sight seem to be justified by its position in Great Britain. It has, however, to be realised that horticulture is an intensive industry employing a considerable amount of labour, and thus any extension of fruit culture or market gardening must immediately and inevitably react in a favourable manner on the rural population.

It is obvious that science cannot of itself redeem an industry which is in the main under-capitalised and very largely unprofitable It should, however, be equally obvious that if the conference of land-owners, farmers, and land-workers recently convened by the present Government can in fact agree on a sound agricultural policy at once far-sighted and acceptable to the nation as a whole, the ultimate success of that policy will be largely determined by the extent to which science is brought to the direct aid of the farmer. It is, therefore, legitimate to examine the organisation which exists to-day for the explicit purpose of bringing science to the direct aid of the farmer, and to do so in the light of what are considered to be the chief necessities of British agriculture, if this industry is to be regarded as of national importance as well merely as of something which concerns the well-being of what is no inconsiderable proportion of our population.

The Commissioners have, of course, realised the necessity of a connecting link between the Research Institutions and the county organisers who are primarily responsible for advising the farmer as to scientific practices. Advisory officers are now attached to fourteen institutions, the majority of these are, however, advisory chemists and pathologists whose chief preoccupation in most cases is to undertake research on laboratory lines into problems of local importance, and in the main they have not the facilities to investigate farm practices as such It is therefore satisfactory to note that Advisors in Economics are now being appointed at some of the institutions, and the work already done, notably at the University of Leeds, would seem to indicate that, particularly when the officers devote their attention to the economics of local practices, they are able to afford signal service to the farmers within their areas. Recent results obtained at the Research Institutes in the realm of animal nutrition have been followed up at college farms by accurate feeding trials, so that it is now possible for organisers who have had the opportunity of gaining personal experience to give authoritative advice to individual farmers, which has in innumerable cases revolutionised the system of feeding adopted In this connexion the pioneer work of Mr. Boutflour in Wiltshire affords one of the best recent examples of the way in which science has been brought to the direct and very substantial aid of the farmer, and has incidentally caused increased production, in this case in terms of gallons of milk. It is perhaps open to doubt, however, whether science has been brought sufficiently to bear on some of the wider and more national aspects of agriculture in Great Britain.

Mr. Edward Wood, the Minister of Agriculture, in recent speeches and referring to the conference of those concerned in the industry he has convened, has emphasised the need of adding to the area under cultivation in Great Britain, not necessarily by merely thinking in terms of wheat alone, and he has directed attention to the paramount need of making our more derelict lands fertile and this whether particular areas are left in grass or brought under the plough. Mr Wood has also directed attention to the serious disadvantage under which the farmer labours in regard to bringing his farm into a higher state of fertility as the result of paucity of readily available working capital.

Broadly stated, then, one of the first necessities, if we are to have a healthy agriculture, is a campaign of land improvement in the widest sense, and from the facts of the case, no matter whether credit facilities are to be afforded to the farmer on a large scale or not, the improvements must be effected on an economic basis.

Here, then, is a concrete, yet highly composite problem, a problem towards the solution of which agricultural science has admittedly accumulated a vast array of data. But the items contributing to such data are largely unrelated and cannot at present be said to constitute a definite and trustworthy practical doctrine.

The allied questions of improving poor land and generally enhancing the fertility of farm lands in Great Britain as a whole are not subjects upon which the organiser can easily persuade the farmer himself to experiment. The problems involved entail, first, difficult economic considerations, and secondly, the elucidation of practical difficulties connected with the type of rotation and systems of cropping most suitable, methods of tillage, processes of manuring, relation of grass to arable, and the choice of the correct varieties and strains of crops The general problem is not, moreover, one that is likely to be adequately dealt with at an institutional farm, for one thing, these farms are frequently of a higher grade than the average of the district which they represent, and for another, it is usually the policy to run such farms in conformity with the generally accepted canons of good husbandry.

Indirectly, valuable work has been accomplished in

the direction of surveying the field by the various soil and other surveys that have been undertaken Hitherto, however, no large sum of money has been set aside for this important work, which has been conducted in a somewhat haphazard manner and in many cases without critical regard to economic considerations In any event, it is work that needs to be conducted on a well-thought-out and uniform plan, under the general supervision of a strong co-ordinating authority The need of a complete agricultural survey showing both actualities and potentialities was rendered abundantly manifest during the War, while if a real endeavour is to be made to stabilise the industry and add to the productive capacity of farm lands in Great Britain, the non-existence of such a record will again be acutely felt

In so far as growing the correct varieties of the chief crops is concerned, it is satisfactory to learn that a grant has been made to the National Institute of Agricultural Botany to enable that organisation to conduct subsidiary trials at carefully selected sub-stations. It is, however, on the poorer and more improvable types of land that variety trials are most needed, while in many cases the type of varieties necessarily handled by the National Institute are not likely to be those best suited to land of the lower productive classes Trials of a somewhat different nature should also be initiated; the aim in the first place would be to discover the degree of productivity of every characteristic district, by setting up a series of properly replicated plots of the same standard variety—of a crop of wide-spread distribution such as oats—on as many farms as possible

This is a procedure that should constitute an important feature of any general scheme of agricultural survey that may be set on foot, for without some really trustworthy quantitative and easily comparable crop data of this sort it is difficult to see how the results of surveys based on soil and other environmental factors can be interpreted to proper economic advantage In the second place, it is exceedingly important to know the range of applicability of new and improved varieties, and it is just as important that the greatest possible number of farmers should be given the opportunity of forming their own opinion of such varieties

With a view to these ends quantitative data are not necessary, or at all events not necessary in the first instance. A strip of, say, Yeoman wheat should be sown on a few fields in every parish in the country in which wheat, in no matter how small quantity, is grown The same would apply to, say, Black Bell III and Victory or Crown oats, while in particular districts it would be easy for the appropriate advisory centres to make proper suggestions as to varieties demanding extensive trials by this means A similar simple method would make it possible rapidly and accurately to define the areas capable of successful lucerne cultivation, to establish the relative merits of widely different strains of such a fundamentally important crop as red clover for widely different habitats. All of these are problems of first-rate importance in relation to profitable land improvement.

More urgent than trials of the character indicated above is the necessity for conducting experiments in the realm of systems of cropping, and the relation of temporary to permanent grass, which would entail equally far-flung but more elaborate and long-continued field trials.

It is true that financial support has been given to further the idea of arable dairy-farming, and that the utilisation of barren sandy land has been under tentative investigation, but these are isolated aspects of the broad question of enhanced crop production and land improvement They are not so much the province of agricultural chemistry or of agricultural botany as understood in Great Britain, but rather of field husbandry or agronomy as understood and investigated in the United States of America, for example

Notwithstanding the work that is in progress in many important directions influencing land improvement, it is probably not too much to say that the problems of field husbandry will not be solved until an *ad hoc* organisation is set up to deal with the matter in a manner analogous to that in which the Research Institutions deal with the fundamental problems of plant breeding and animal nutrition, for example, or the way in which the advisers in agricultural chemistry deal with their local problems. It is doubtful, however, if a single Research Institute of field husbandry would adequately meet the case—numerous sub-stations would certainly be a necessity It is, however, the principle that field husbandry is not at present a matter of demonstration, but is essentially a matter demanding field investigation of a most rigorous and accurate character, conducted without bias and in a true spirit of research, that must be realised. Two things are essential, namely, a co-ordinating authority and the appointment of men in the counties backed with facilities for conducting field investigations on carefully selected areas A useful beginning could undoubtedly be made if advisers in field husbandry were appointed at institutions serving backward and infertile districts, while co-ordination could be assured by the appointment of an officer at the Ministry of Agriculture charged with the supervision of the work as a whole It is probable that in some cases suitable land could be taken over for experimental purposes from the not inconsiderable areas now under the control of the Forestry Commission, while it is more than likely that land-owners and farmers would be found in very appreciable numbers who would be willing to assist in such an important undertaking.

Human Geography.

Human Geography: an Attempt at a Positive Classification—Principles and Examples. By Jean Brunhes. Translated by Prof. I. C. Le Compte. Edited by Isaiah Bowman and Prof. Richard Elwood Dodge. Pp. xvi+648. (London, Calcutta and Sydney: G. G. Harrap and Co., Ltd., n.d.) 21s. net.

THE student of modern geography by whom this classical work is read for the first time, might well feel that even in the few years, little more than a decade, since the original issue, most of this manual has become, if not out-of-date, at least somewhat antiquated. A youthful applicant for a situation was asked "Where is Tokyo?" He replied, "I do not know." The employer expressed his astonishment in vigorous terms, and the youth continued, "But if you will tell me where it is, I will tell you why it is there." This youth was a product of his period; the geography of to-day seeks to answer the question "why?" The aim of modern geography is to probe, to evolve generalisations, to eliminate and thus simplify complex phenomena in which the psychological factor is of supreme importance.

M. Brunhes provides a useful corrective. He writes and argues about what he has seen; he aims at a manual, not a treatise, at a collection of observed facts, not an explanation. Again and again he advises caution. The fundamental fact is place-relation, and he shows repeatedly how every thinker whose subject-matter implies some form of human activity needs the geographic sense. The Ricardian law of diminishing returns does not apply where the land, as such, is not the fundamental basis of property. Again and again the reader is referred to six essential facts: houses and roads, cultivated fields and domestic animals, exploitation of minerals and devastation in plant and animal life—facts familiar enough under a slightly different grouping of ideas in the terms shelter, food, and communications.

By numerous illustrations and digressions the reader is led to an idea of geographic method, to a manner of attack upon a seemingly heterogeneous collection of an apparently endless mass of isolated facts, and the whole outlook may be summarised under the query "how?" not "why?" A heavy snowfall is to be expected in January in New York and other places where the mean January temperature is about, or below, freezing point. The "why" of this fact belongs to the domain of physical science: the recognition of the fact as a possible factor in regard to man's life on the earth belongs to physical geography. So far everything is simple, but the human geographer asks the question how is man affected? It is his business to find out how man reacts to this circumstance, and he finds widely different answers for different parts of the world. The response in New York is different from the response in Italy, and so he arrives at the fundamental concept of location, the tyranny not of Nature as a whole but of place-relationship within Nature.

M. Brunhes is deliberately didactic; he teaches by selected samples and begins with the simplest examples. The easiest studies refer to islands—not only the real islands of the sea, but also the land islands where a community is relatively isolated by physical circumstance; his study of the Balearic Isles leads to thoughts about Java or Japan. Herein, it would appear, lie the elements of age which might repel the modern student, for there is little consideration of the world as a whole; there is no room for the current broad generalisations which underlie the idea of the "major natural regions of the world." A regional synthesis, however, is not lacking. A map of Spain, for example, shows within the area of dry Iberia five regions of steppes and irrigation, and so illustrates a regional classification based, not upon the facts of climate, but upon the ways in which man has responded to one particular element, water supply.

In the last chapter it is argued that space, distance and difference of level are fundamental geographical facts which are becoming more and more the sovereign masters of men, and the final conclusion is reached that "Every people . . . covers the surface of the earth with those outward and visible signs . . . which allow us to divine its past and sometimes even its future." Whither does all this lead? Apparently to the notion that geography is not a science, not an ordered body of knowledge, which is independent of the personality of the investigator, not a set of conclusions which must be universally valid, not a statement of generalisations valid for all time or for every place, but primarily and fundamentally a discipline, an outlook on man's life on the earth, which gives to the thinker that unique geographic sense so invaluable for the law-maker, the captain of industry, and the merchant prince, so useful a corrective in all matters which pertain to the conduct of human affairs on the large scale.

Whatever view may be taken, it must be confessed that the facts of geography are stubborn; they cannot be melted in the mental furnace and run into set moulds; they frequently misfit the theories: but the spirit of geography is of unique value. No other human study permeates so many of the sciences: no other study is so necessary to the equipment of the educated man.

Optical Measuring Instruments.

Optical Measuring Instruments, their Construction, Theory, and Use. By Dr L C Martin (Applied Physics Series) Pp ix+270+8 plates (London, Glasgow, and Bombay Blackie and Son, Ltd, 1924) 17s 6d net

"OBTAIN a measurement, however rough, then endeavour to get a better," was the advice that Lord Kelvin used to urge upon his students Quantitative analysis is the natural supplement of qualitative reasoning One rough estimation may serve to exclude a multitude of suppositions; one precise measurement may serve to indicate the definite conclusion of an investigation But to make a measurement, even an approximate one, is not always easy Precise metrology is a difficult art It demands an understanding of the problem, access to the requisite apparatus or, failing instrumental means, the capacity to design and, if necessary, construct whatever appliances may be required, skill in their adjustment and use, and, above all, the will to discard the obvious, which in metrology is not always the truth

As there is no superfluity of literature devoted to this particular subject, any new contribution, such as Dr Martin's work on "Optical Measuring Instruments," will surely be welcomed As the author has stated in his preface, "The selection of instruments for description is extremely difficult" It is unlikely, indeed, that from the great mass of material that is nowadays available the same selection would be made by many With the exception of Chap vii. devoted to rangefinders, it would appear that instruments of warfare have intentionally been rigorously excluded All the appliances cited have an essentially peaceful character They comprise measuring microscopes, micrometers, comparators, the divided circle, theodolites and sextants, levels, spectrometers, refractometers, spherometers, focometers, photometers, and saccharimeters In the final chapter, "Errors and Accuracies of Observation" are discussed rather more briefly than the importance of this question would warrant

There is a similar brevity in the presentation of the general principles forming the subject of the first chapter, where the author in his discussion of the principles of geometrical supports is to be congratulated upon his emphasis on the importance of the physical conditions These first and last chapters might well have been extended at the expense, if necessary, of other sections For example, although the divided circle is a highly interesting precision tool, it is scarcely an optical instrument when stripped of its reading microscopes which are dealt with in the preceding chapters. Rangefinders, which are essentially militaristic in character and of correspondingly limited interest, might also have been excluded, if thereby space could have been provided for a chapter upon that premier optical instrument of supreme accuracy—the interferometer, which has been brought in Great Britain to so high a standard of perfection The chapter on the rangefinder, and particularly the stereoscopic portion, is the least satisfactory section of the book Evidently the author is unaware that the German claim which he emphasises on p 121 has been disproved beyond doubt as the result of extensive trials made by most of the principal powers interested in this subject, and that many important gunnery officers of the German Navy no longer accept it

Dr. Martin's book has the merit of originality. It is not a compilation from other works Originality in a first edition demands, however, particular care in the avoidance of errors, and unfortunately there are throughout this book mistakes of so obvious a kind that it is difficult to understand why they should have escaped correction In Fig 45, which illustrates the application of an inverting prism to a sextant, the rays are quite incorrectly traced, as they are not shown touching the reflecting surface which determines the inversion of the image All three diagrams of Fig 93 are also incorrect A ray normal to the surface of the prism (*a*) is shown refracted In the next diagram, representing the same prism, the ray entering as before at scraping incidence is now shown refracted away from the base, the refracted ray within the dense flint prism being shown in an impossible position. According to Fig 93 (*c*), a beam of light passing through an equivalent plane parallel plate is wrongly represented as suffering severe refraction instead of emerging parallel to its original direction

The mistakes are not confined to the illustrations: they occur also in the text As an example, the "special problem in angular measurement" at the end of the chapter on theodolites and sextants may be cited. The problem indicated is to measure the inclination of two lines It is proposed, instead of suitably rotating the cross-wire of a telescope with reference to the lines and a scale, to make use of a rotatable inverting prism As the author states, if such a prism is rotated about the direction of view, the inverted image rotates at twice the angular speed of the prism, and the conclusion is arrived at that greater accuracy of measurement is attained by these means But, as the problem is the measurement of a particular angle, the prism will require to be rotated through only half the angle to be measured, and the comparative accuracy will accordingly be halved

Although the majority of the mistakes are obvious ones, they may prove confusing to a thoughtful student, and more careful revision, particularly of the illustrations, is desirable in any future edition of the work

JAMES WEIR FRENCH

Sands and their Uses.

Sands and Crushed Rocks By Alfred B Searle. (Oxford Technical Publications) Vol 1: *Their Nature, Properties and Treatment* Pp xiv+475 Vol. 2: *Their Uses in Industry*. Pp ix+281 (London: Henry Frowde and Hodder and Stoughton, 1923.) 52*s*. 6*d* net

MR. SEARLE has made an attempt to fill a gap in technical literature by a work which deals, in all aspects, with the subject of sands and crushed rocks According to the author, the purpose of the work is "to summarise in a convenient form such geological, chemical and mineralogical information on sands as is likely to prove of value to those engaged in the digging, sale, and many uses of these materials." To the reviewers, however, it seems that the author's enthusiasm for detail, much of which appears irrelevant, has defeated this purpose.

A glance at the table of contents will reveal the varied nature of the material gathered together in Volume 1 Commencing with the origin and formation of sands, we finish with a chapter on their storage, packing and despatch In Chap iii, ninety pages are devoted to a catalogue, arranged in alphabetical order with descriptive detail, in which names are given to nearly one hundred and fifty sands! For no obvious reason, a description of a carborundum furnace is here included. Incidentally, there seem to be but few substances which, according to the author, do not come within the purview of this subject For example, ground glass and metal filings are stated to have been used as "sands" in concrete, while "breeze" is described as an artificial sand consisting of sifted ashes. The writer has departed considerably from the customary definition of a sand as a natural, detrital and non-plastic deposit Chap. iv., written on similar lines, deals with some of the mineralogical constituents of sands, while in the next two chapters their properties, as well as their examination and testing, are described.

The remainder of this volume is concerned with the treatment which sands and sand rocks undergo before use It is profusely illustrated, but many of the photographs are reminiscent of the advertisement catalogue.

The second volume of the work enlarges upon the uses of sands and crushed rocks in industry. The uses of these materials in brick-making, in road construction, as refractory materials, in agriculture, in glass-making and in metallurgy, to mention only a few of the more important applications, all receive attention

Many statements to which exception may be taken seem to have escaped the author's notice For example, Stokes's law is first written as $V = \frac{2D-d}{9\varsigma}$ and then quoted correctly on the next line Referring to the constant weight obtained when a material has been fully dried we find the statement that "this weight, less that of the bottle and contents previous to drying, is the amount of moisture in the weight of materials used" In connexion with electrostatic separators, we are told that "a still more definite separation will take place if the whole of the material is first charged negatively and is then brought into contact with a positively charged body," while it is also stated that the "mean coefficient of expansion of silica between 0° C and 1000° C. is 0·68" Again, the figure on p 437 (I.) given in illustration of a "gas-fired" furnace does not represent a gas-fired furnace. Finally, we are told that "a tunnel-kiln efficiently insulated with kieselguhr on the sides and roof can usefully employ 98 per cent of the available heat in the fuel"

Elsewhere, there becomes apparent a certain looseness of style, and this gives rise to statements which may be ambiguous or often misleading For example, the refraction of light is described as the *turning* of a ray of light, while on p 208, Vol. 1, it is explained that doubly refracting materials "turn a ray of white light through several different angles, so that the rays are termed ordinary and extraordinary rays"

Moreover, the book contains inconsistencies, one example of which cannot be allowed to pass unnoticed "Tridymite bricks are silica bricks in which the whole of the silica has been converted into tridymite. . . No brick on the market consists entirely of the low specific gravity forms of silica."

The breadth of field which the subject covers, the inaccessibility of many publications, and considerations of space, are put forward in the preface as a plea for the omission of full references But surely the time has come when few technical or scientific works, other than the most elementary, can stand the test of publication without the support which adequate references to the literature of a subject gives The necessary space could have been gained by the elimination of much of the unnecessary matter and by avoiding repetition

A judicious selection of the references the author must have accumulated during the many years in which, as he tells us, he has read the leading journals

on the subject, would undoubtedly have enhanced the value of this book and been of permanent worth

The volumes are well printed and well presented, but the price is high, and the author would have done well to have compressed his subject-matter into a smaller space Doubtless much useful information will be found, especially in the second part, by those for whom the author has written, but the gap in the literature still remains

L S T
W. E

An Oxford Sketch of the Evolution of Thought.

Speculum Mentis, or the Map of Knowledge By R. G Collingwood. Pp 327 (Oxford at the Clarendon Press, 1924) 12*s* 6*d* net

MR. COLLINGWOOD has a tradition of art behind him and he has also made himself recently one of our leading authorities, if not the first of all, on Roman Britain As he adds to this a profoundly philosophic mind, his attempt in this book to survey tne whole field of human thought has some material for its foundation It is modest in expression though ambitious in scope, and will interest greatly those who like to trace a line of thought faithfully pursued by a thinker who wrestles hard with every conclusion, and gives the public nothing but what he has won from his own experience, intensely felt

The general thesis of the book is that the human mind, whether in the individual or in the race, passes through a series of experiences each of which is incomplete and partially corrected by the succeeding stage, until it rests at last in a philosophy of absolute or final worth based on the mind itself, enlightened by history It will be seen that there is a large heritage from Hegel here, and if one wished to describe the point of view in terms of older thinkers who have influenced the writer, one would say that it was Hegelianism plus Croce. But this would do scant justice to Mr Collingwood's sincerity of thought and striking individuality One appreciates the book most as a personal revelation.

Art is the first, and always the primitive, stage of thought; and this passes into the kindred, concrete and unanalysed stage of religion Analysis, when it comes, gives us science, which appears in Mr Collingwood's hierarchy of thought as the middle term Art and religion are below or before it history and philosophy above or after We are not to imagine that the lower stages are entirely superseded by the higher, they are rather corrected and subsumed in a fuller point of view

The use that Mr Collingwood makes of the recent historical spirit in science is very apt and enlightening It is the clearest and most conclusive part of the whole book During the nineteenth century many of the sciences, as he tells us, restated their problems in terms of history Astronomy realised that its proper task was to explore the history of the stellar universe, geology and geography united to study the history of the earth, and biology came to see that the problem of species is the problem of the origin of species "The time seems near at hand when science will feel the need of absorbing itself bodily in history and re-shaping its problems throughout in historical terms"

This passage from science to history is one of the numerous points in the book where a penetrating light is thrown by the author's synthetic and persevering thought He might perhaps have made his effect better by a little more compression There is a good deal of repetition, and the reader himself needs perseverance, but he will be richly rewarded It is one of the most profound and suggestive treatises of recent years

F S MARVIN

Our Bookshelf.

The Design and Working of Ammonia Stills By P Parrish Pp 300. (London Ernest Benn, Ltd, 1924) 40*s* net.

THREE hundred thousand tons of ammonium sulphate are produced annually in Great Britain by the direct distillation of the ammoniacal liquors arising from coal and shale products Even from this consideration alone, the publication of the first standard comprehensive book in English on the design and working of ammonium stills must be regarded as an event not only of scientific but also of economic importance Many chemical manufacturers in the past for various reasons have endeavoured to keep their processes strictly secret, and improvements have come from internal experience on the plant rather than from general physico-chemical considerations or from a combined study of the theoretical and applied aspects of the problem or difficulty encountered "Collaboration," Dr Charles Carpenter notes in the preface, "between those responsible for the design of large-scale chemical plant can only be a war-time measure" Mr Parrish will help to some extent to remove in one industry this individual outlook and veil of secrecy, for in his book he has collected together a great amount of novel information of a fundamental and authentic character on the subject of ammonia stills and accessory plant This carefully-edited book, which includes 170 excellent illustrations and 70 technical tables, must benefit the industry generally and secure a common outlook for new developments on other than empirical lines

It is indicated that the greatest economy in the manufacture of ammonium sulphate is likely to accrue from a better utilisation of the available heat of the process, and the aim of the author has been to show how this can be achieved In fact, so keenly has the point been emphasised that the volume might be

called the design of ammonia stills in relation to steam economy and the utilisation of potential heat The fundamental principles underlying the design of stills, preheaters, condensers, dephlegmators and coolers all receive thorough consideration in this connexion. The opinions put forward are those of a successful works' chemist who writes more particularly for the benefit of other gas chemists and engineers rather than for the guidance of the chemical student

A note of criticism might be made on the general use of chemical formulæ in a somewhat loose manner, while the chemical equations given are not always correct.

In conclusion, it should be stated that the financial aspect of the subject of ammonia distillation also receives detailed treatment, and the author makes every effort to indicate the economic soundness of processes under particular conditions

JOS REILLY

The Subject Index to Periodicals, 1921 Issued by the Library Association *B-E · Historical, Political and Economic Sciences* Pp 106 21s net *F Education and Child Welfare* Pp. 28 4s net (London Grafton and Co, 1924)

WE welcome these two sections of the Subject Index to Periodicals published by the Library Association They maintain the high standard attained in previous sections of this catalogue. These sections index papers published in 1921, so that the Association is now allowing a little less time to elapse between the date of publication of the original papers and that on which the Subject Index is issued. It would, of course, be more useful to those engaged in scientific work if it were found possible to shorten the interval to somewhat less than three years, and the Library Association will, no doubt, when it has overcome all the difficulties connected with a work of this kind, find it possible to issue its Indexes within a period of two years from the date of publication of the periodicals indexed.

Among those subjects in the section on historical, political and economic science to which particular attention has been paid we notice agriculture, banks and banking, bolshevism, chemical manufacturers, coal trade, co-operation, the Eastern question, employees and employment, ethnology, the European War, fisheries, forestry, international law, labour, mines, railways, shipping and wages.

The section on education and child welfare will be of great value to those who are devoting themselves to the study of these subjects. An examination of the 54 columns of titles of papers in this section will show the direction in which the thoughts of those advocating reforms have been chiefly turned. We note especially educational psychology and mental tests, and papers on the position of teachers. Papers on the teaching of citizenship are grouped together, as are also those on abnormal and backward children. The question of classical education has, of course, a heading to itself. Papers coming under the general head of education occupy nine columns of the Index, but these are subdivided under various subheadings which make reference easy. There are also headings for science study and for technical education

Thysanoures, Dermaptères et Orthoptères de France et de la faune européenne Par Prof C Houlbert (Encyclopédie scientifique Bibliothèque de Zoologie) Tome I Pp xii+382 (Paris Gaston Doin, 1924) 16 francs

THIS clearly written and well-arranged little volume forms a handy and up-to-date work of reference to the orders of insects concerned The longest section (Part I) is devoted to the Apterygota or, as Prof Houlbert prefers to term them, the Thysanura These he divides into the two sub-orders Collembola and Monomorpha (Thysanura of most authorities) It is prefaced by a general account of their structure (based largely upon the work of Willem), and there follows an exceedingly useful series of family and generic keys, along with descriptions of the various species This section of the volume should appeal to many entomologists since it provides a readily accessible guide to the insects of those two orders The work of Lubbock has long been out-of-date, and the student has hitherto had to rely upon various scattered memoirs (some not easily procurable) for the identification of his material Part II deals in a similar manner with the Dermaptera, and Part III is devoted to the general structure and habits of the Orthoptera, descriptions of the species of the latter order being reserved for a second volume The book is fully illustrated and has ample bibliographical references

A D I

A Comprehensive Treatise on Inorganic and Theoretical Chemistry By Dr J. W. Mellor. Vol 5 *B, Al, Ga, In, Tl, Sc, Ce, and Rare Earth Metals, C*, (Part 1) Pp x+1004 (London. Longmans, Green and Co, 1924) 63s net.

THE new volume of Dr. Mellor's Treatise includes boron, aluminium, and the rare earth metals, together with a considerable part of the section on carbon. The style and general method of treatment are similar to those used in the earlier volumes and do not call for any comment Perhaps the most striking feature of this volume is the treatment of the complex compounds of boric acid Some of these can only be expressed by formulæ such as $KMg_2B_{11}O_{19}$, $9H_2O$, $Mg_7B_{16}O_{30}Cl_2$, or $Cd_5\{H_4[B(W_2O_7)_6]\}_2$, $51H_2O$, and would certainly be omitted from any elementary text-book, but they all find a place in the comprehensive treatise of the author, just as readily as if their compositions could be expressed by formulæ of the simplest kind

The "Chemical Age" Chemical Dictionary Chemical Terms. Pp 158. (London: Ernest Benn, Ltd, 1924) 16s net.

THE dictionary gives the definitions and in many cases short descriptions of a large number of terms used in chemistry. Practically all branches are covered, and the book is up-to-date A few sections, taken at random, were · deanimation, hæmacytometer, isomerism, oligodynamic action, quinocarbonium, thermodynamics, ultramicroscope, and X-ray analysis, and in each case a clear and accurate account of the topic was presented The book should prove useful to technical journalists and for general reference, as well as to chemists

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Resonance Radiation and the Correspondence Principle.

THE experiments of Wood and Ellett[1] on the polarisation of the resonant radiation of mercury suggest that it is necessary to make a rather important modification in the quantum theory. The theory of the phenomenon has been examined by several writers,[2] among whom Eldridge has most explicitly directed attention to a case of difficulty. He shows that the observations in a magnetic field are a natural consequence of regarding magnetism as equivalent to rotation, provided that the effect without field is given, but that this effect without field conforms rather to the classical than to the quantum theory.

This is the difficulty. Suppose light of wave-length 2537 Å.U. going northwards and polarised with electric vector in a vertical plane—the points of the compass are merely used to describe relative directions. If this light falls on mercury vapour, an observer to the east sees the resonant light almost completely polarised in a vertical plane, and one above sees practically no light at all. The wave is that which, on the classical theory, would be emitted by an electron vibrating in a vertical line; it may conveniently be called a *linear* wave, and similarly the wave emitted by an electron revolving in a circle may be called a *circular* wave. According to the quantum theory, the resonant line of mercury is associated with a change of angular momentum, and so each atom should emit a circular wave. There is little known in the quantum theory about the process of excitation, but as the electric force is vertical it is natural to suppose that it would give the atom angular momentum about some horizontal axis. However that may be, the radiations from the separate atoms are not coherent, and no possible combination of incoherent circular waves can give rise to a linear wave.

Some sort of explanation could perhaps be constructed by supposing that the electric force in the incident light itself orientated the atoms, and that the resonant radiation was controlled by a Stark effect. This does not really remove the difficulty, for if the vapour were illuminated by circularly polarised light the atoms would have continually to re-orientate themselves, and at such a rate that the concept of the angular momentum of the atom would lose all meaning. The plain fact is that we are dealing with a "degenerate" system, and the degeneracy is of a new kind, exhibiting itself externally and not merely as a purely conceptual question. Any explanation has to face the fact that the atoms are orientated arbitrarily. Since they react to the light in a manner independent of this arbitrary orientation, we must suppose that each single atom is somehow much more isotropic than would be admitted by the ordinary Bohr model. This isotropy might perhaps be attained by supposing the process of excitation to be so slow that the atom passes through all phases of its motion before it is complete.

The correspondence principle was formerly enunciated as a rather precise rule by which the results of classical mechanics could be transferred into the quantum theory. There has, however, arisen a tendency to take it in a wider and vaguer sense, as a statement that to any suitable classical theorem there will be an analogue in terms of quanta, and the remaining difficulty is the decision of what theorems are suitable. The present phenomenon strongly suggests a well-known theorem which has not yet been used. A mechanical system vibrating about a state of equilibrium or steady motion usually possesses a unique set of normal modes of vibration, but if some of the frequencies are exactly equal, the modes become ambiguous. Thus a particle vibrating in a plane with equal frequencies for the two directions can describe not only right- and left-handed circles, but also a straight line in any direction. If we apply the correspondence principle to this theorem, it says that if an atom can emit circular waves of equal frequency in either sense, then it can also emit linear waves. We are applying in quite a different branch of the subject Bohr's view of degeneracy; compare it, for example, with his view that in ordinary elliptic motion the eccentricity is not to be quantised, but may have any value.

The accepted form of the quantum theory does not, of course, admit that the same atom can emit both types of circular wave from a given stationary state, but we have seen that it fails to explain the resonance, and the present suggestion is the most natural, if not the only one, which can do so. It must be remembered that there is no direct evidence at all for the emission of purely circular or linear waves from the single atom in the absence of a magnetic field. When there is a field, the degeneracy disappears, the frequencies become unequal, and our theorem is replaced by the straightforward quantum explanation.

There is no avoiding the fact that the theorem has an effect on the quantum theory which is absolutely devastating. Thus there is a failure of all the arguments concerned with the angular momentum of the atom, and therefore of the physical reality of the Bohr orbits. It must, however, be noticed that an idea is entering which is new to the quantum theory, for as the atoms are arbitrarily orientated, the phenomenon requires a definite statement of *phase*. In all previous cases the various linear and circular waves have had unequal frequencies, and so no question of phase arose. There seems to be no reason to give up the concepts connected with angular momentum so long as they are confined to non-degenerate systems or to degenerate systems in which the character of the degeneracy is not studied, and we may expect great further progress by their use. But these concepts are to be regarded, not as ultimate reality, but as a convenient short-cut to the study of complicated systems, and the correspondence principle ought to be applied to the more formal and less physical description of the atom. It is not surprising that the older theory should fail over resonant radiation, for it has shown a complete inability to deal with the other important problem in which phase plays a part, the refraction of light.

It is perhaps possible to argue that a modification might be made in our conceptions of emission without disturbing our ideas of the quantised orbits of the electrons. Even this is not without difficulty, though perhaps it is less insuperable. We have to suppose that the atom is raised to its p-state by the action of the electric force, and that it remains there for a time of the order of 10^{-8} sec. During this time

[1] Wood and Ellett, Proc. Roy. Soc. A, ciii. p. 396, 1923.

[2] Breit, *Phil. Mag.*, xlii. p. 832, 1924; Gaviola and Pringsheim, *Zitschr. f. Phys.*, xxv. p. 367, 1924; Eldridge, *Phys. Rev.*, xxiv. p. 234, 1924, and others.

the precessions and apsidal motions of the electrons will be very large indeed, and it is difficult to see how the atom could, so to speak, remember for so long the axis of the wave it is to emit. Angular momentum would have furnished such a "memory," but the electric force can contribute none about the proper axis.

The discussion is not complete without considering sodium vapour and other substances,[3] but it would take too long to discuss them here. On account of the multiplicity of levels in a magnetic field the effect is more complicated, and the quantum theory is conspicuously successful in explaining the imperfect polarisation, but the difficulty with no field remains outstanding and seems to require the same hypothesis as does the more extreme case of mercury.

May I take this opportunity for a word of personal explanation? At the time that Wood and Ellett were doing their experiments, Prof. Wood very kindly communicated them to me and asked me for an explanation of them. I wrote this back to him in a rough form, making use of a trigger idea for the excitation. I was only regarding this as a quick way of using the classical theory without introducing the fundamental difficulties which lie at the root of it, but I had no opportunity of casting the explanation into a more conventional form in accordance with that theory. I must confess I also had the impression that it would go as well in terms of quanta, but I certainly had no idea either of the special success which would attach to the cases of sodium, etc., or of the difficulty which is the subject of the present letter.

C. G. DARWIN.

The University, Edinburgh,
January 2, 1925.

[3] Ellett, NATURE, December 27, 1924, vol. 114, p. 931.

Transmission of Stimuli in Plants.

IN an article in NATURE of October 25 Prof. Dixon[1] has reviewed an investigation of conduction in *Mimosa pudica* which I lately carried out in Trinidad.[2] He agrees with my conclusion that "normal" conduction in the stem has been correctly explained by Dr. Ricca as depending on a stimulant moving with the transpiration current in the wood, but disagrees in that he inclines to consider that Dr. Ricca's explanation is adequate to cover *all* the phenomena of conduction in Mimosa, including conduction in the leaf and the subordinate phenomenon of "high-speed" conduction in the stem. He offers no positive evidence tending to support this view, but criticises the evidence from which I have concluded that Dr. Ricca's explanation will not cover the whole ground.

This autumn, working on *Mimosa Spegazzinii* in Sicily, I have obtained further evidence which confirms my previous conclusion, and provides an answer to several of Prof. Dixon's criticisms, with most of the remainder of which also I am unable to agree. It was found, for example, that in the leaves of cut shoots that had been totally submerged under water for two or three hours, excitation was conducted in both directions considerably *more* rapidly than in similar leaves in air and still attached to the plant. Yet in the stems of such shoots, the velocity of the transpiration current, as measured by ascent of stain, was reduced to about 1 cm. per minute, as against a rate of about 5 cm. per minute in shoots with their leaves in air.

Again, the experiment was repeated of cutting off the tips of leaves under a stain. Previously it was found that in most cases the stain failed to enter the vessels at the leaf tip. The explanation may be that the vessels in some way got blocked, as Prof. Dixon suggests—a possibility that ought certainly to have been taken into account before. But this time the leaves were so manipulated that the stain always entered the vessels. It was, however, sucked back down the leaf at the rate of from 1 to 2.9 cm. per minute only, while in the same leaves at the same time excitation was conducted down at speeds from 6 to 12 cm. per minute.

Similarly, in detached leaves that had stood for some hours with the base of the petiole in water, the rate of ascent of stain was only from 1 to 2 cm. per minute, while at the same time excitation was conducted up them at speeds from 6.2 to 16 cm. per minute. The movements of water in the vessels cannot, therefore, account for excitatory conduction even in the leaf of *M. Spegazzinii*, in which it is much less rapid than in the leaf of *M. pudica*. The results also show that in the leaf the transpiration current ascended much more *slowly* than in the stem, whereas excitation, in *M. pudica* at least, is conducted far more rapidly in leaf than in stem. The details of these experiments it is intended soon to publish.

With regard to Experiment 11, in which all the wood was cut through in the petioles of leaves of *M. pudica*, Prof. Dixon says that it is hard to see why excitation could not have been conducted down by a stimulant passing down the wood and crossing the watery gap. The reason is surely clear. In order to explain basipetal conduction in the leaf by movements of water in the wood, it is necessary to suppose, as Dr. Ricca and Prof. Dixon have supposed, a state of tension in the water columns, which is released by cutting the leaf tip. But in this case, the cut in the petiole had opened up all the vessels to the surrounding water in which the cut was submerged all the time, so that no adequate tension can have existed. It is, therefore, impossible that a stimulant in the water columns should have been sucked back even down to the cut, let alone passing it, as did the excitation, and reaching the main pulvinus, a total distance of about 7 cm., in 3½ seconds. It can only have travelled by the phloem. The conditions were absolutely different from those in the "discontinuity" experiments on the stem, in which a water-tight joint was made between the two portions of stem, in order that the stimulant might be sucked over from one to the other. Moreover, it was pointed out that the next experiment (Expt. 12), which Prof. Dixon does not mention, shows that in preparations consisting of a portion of stem carrying one leaf only, similar to those on which the above experiment also was performed, excitation cannot be conducted basipetally by movements of water in the wood. For the killing of a zone of the petiole by a jet of steam was found absolutely to prevent all basipetal conduction, though acropetally excitation could still be conducted—no doubt by a stimulant moving up in the transpiration current (Expt. 13).

Prof. Dixon does not refer either to the remarkable and more numerous experiments, which I quoted, by Prof. Herbert,[3] who, with a skill much greater than I could provide, had previously interrupted, in various ways, the continuity of the various tissues of the petiole of *M. pudica*, and had concluded that the path of conduction is the phloem. It would be regrettable if proper notice were not to be taken of Prof. Herbert's work, just because he has published in a little-known journal.

Finally, with regard to high-speed conduction in

[1] Dixon, H. H., NATURE, vol. 136, p. 626, October 25, 1924.
[2] Snow, R., Proc. R.S., B, vol. 96, p. 349, 1924.

[3] Herbert, D. A., *The Philippine Agriculturist*, vol. 11, No. 5, 1922.

the stem, Prof Dixon seeks to explain this as due to a "rupture of the tensile sap" in one or two vessels In cases in which the cut that set up "high-speed" conduction was found to have reached to the cambium only, and not to the wood, he supposes that the sap in the vessels was ruptured by pressure from the razor upon adjacent cells he quotes in support certain observations by Bode Since the cuts were made obliquely and slowly with a sharp razor, there can only have been very slight pressure on the vessels Further, on looking up Bode's work[4] (p 101 *seq*), it will be seen that he does indeed state that pressure from the flat side of a lancet-needle caused bubbles to appear in uninjured vessels of various plants, though strong pressure was needed except in wilting shoots But he goes on expressly to point out (p 103) that yet the columns of sap did *not* break A film of water surrounded the bubbles, which were seen gradually to disappear

Moreover, my experiments were made on cut shoots, cut under water and rested with their bases in water for at least $1\frac{1}{2}$ hours No doubt in the upper parts of these shoots there was considerable tension on the water columns owing to the resistance of the conducting channels below But I find in my notes five cases in which the cuts that set up "high-speed" conduction were made in the basal internodal portion, less than 4 cm long, below the lowest leaf, including one in which the cut was only 5 mm from the extreme base, and another in which the cut reached only down to the cambium In these basal stem portions it is hard to see how there can have been much tension on the water columns In still another case (Expt 7) "high-speed" conduction was set up by cutting off a short length from the base of a shoot totally submerged for 3 hours under water It does not seem possible, therefore, to explain the "high-speed" conduction of the stem either by movements of water in the vessels

In his letter of January 10, Sir J C Bose gives the impression that I have disagreed entirely with his views on conduction in Mimosa Actually, however, in agreement with him I have produced evidence to show that in the leaf, excitation is conducted in the phloem and has nothing to do with the transpiration current I agree also that this conduction in the leaf is, in all probability, a true physiological process, and consider that Sir J C Bose's experiments on the petiole, which so strongly support this view, are of very great value In the stem, however, as I found, this conduction in the phloem either fails completely, or at least is regularly too weak to cause the leaves to fall The result is that in the stem, Dr Ricca's slower mechanism of conduction by the transpiration current is able to reveal itself With regard to the "discontinuity" experiment on the stem, it is difficult to take seriously Sir J C Bose's suggestion that Dr. Ricca and I both committed the truly remarkable blunder of being misled by a direct effect of the stimulating flame upon the leaves above the water-filled tube It is impossible that such an accident should have caused a perfectly normal conduction up the shoot, in which the next leaf above the tube did not fall until about 40 seconds after the leaf below the tube I would refer him to Dr Ricca's original experiments also, who kept his shoots horizontal If Sir J C Bose has failed to repeat this experiment on the stem, this can only be because his experimental arrangement is unsatisfactory

R SNOW

Magdalen College, Oxford

4 Bode, H R, *Jahrb. f wiss Bot*, vol. 62, 1923

The Velocity of Oxidation of the Metals and the Structure of Coloured Oxide Films.

WHILE general opinion ascribes the appearance of temper colours to interference between the light reflected from the outer and inner surfaces of a coherent film of oxide, no very definite proof has hitherto been brought forward that this view is correct, and many opinions have been stated to the contrary The observation of Mallock (Proc Roy. Soc 94A (1918), 566) that the colours are unaltered in hue and only diminished in intensity by grinding away the film, has appeared to many to be irreconcilable with the hypothesis that interference is the cause

We have recently obtained evidence which we believe to render indisputable the claim for interference In a series of papers published recently in the *Zeitschrift fur Anorganische Chemie*, Tammann has described experiments in which he made use of the film colours (assuming interference as their cause) to measure the rates of "dry" oxidation of the metals For many of the metals he found the velocity of oxidation to be proportional to t^{-1} (t being the time reckoned from the moment of first exposure to oxygen), the proportionality factor being dependent on the nature of the metal, its temperature, and on the partial pressure of the oxygen In the course of a study of the oxidation of zinc, in which the rate of fixation of the oxygen was determined directly, it has been found in this laboratory that the rate of reaction is proportional to $t^{-(1-a)}$, where a is small as compared with unity While these measurements are not therefore in complete agreement with those of Tammann, the close approximation of the two expressions would appear to constitute a quantitative proof that interference is the true explanation of the colours

Ill-defined colour changes were occasionally noticed in the experiments on zinc described, but since it was necessary to sublime the metal *in vacuo* (to free it from occluded gases), no estimate could be made of its surface area C N Hinshelwood, however, (Proc Roy Soc 102A (1922), 318) gives data for the oxidation of copper from which it is possible to make a comparison of the amounts of fixed oxygen (which he determined directly) with the thicknesses of the films as estimated from their colours Assuming the oxide formed to be cupric oxide, Hinshelwood gives the following data

Gm of CuO per sq cm of Copper Foil	Colour of Film
0 000030	Purple
0 000043	Blue
0 000073	Light Green

If, as the interference theory would require, the oxide forms a coherent film which clings tightly to the metal, Tammann is almost certainly correct in supposing that the oxide primarily formed on copper is cuprous and not cupric oxide For while in the space-lattice of the lower oxide the copper atoms are arranged precisely as in the metal itself, and at nearly the same distance apart (so that the passage from the metal to this oxide can take place with a minimum of disturbance) the higher oxide has a much more complex structure which could only be formed by the breaking up of the original lattice-pattern Taking the density of cuprous oxide to be (roughly) 6 gm/c c and its refractive index as 2 7, the thicknesses of the air-films which should give colours corresponding to those shown by cuprous oxide films containing the above amounts of oxygen per sq. cm.

are calculated to be, respectively, 243, 348, and 590$\mu\mu$. Referring, for example, to the Landolt-Bornstein "Tabellen" for the colours characteristic of air-films of about these thicknesses, one finds the following

257$\mu\mu$ Purpur $\begin{cases} 300\mu\mu \text{ Himmelblau} \\ 352 \quad \text{Heller Himmelblau} \end{cases}$ 600$\mu\mu$ Meergrun

If interference were not the cause of the phenomenon, it would be a sufficiently curious coincidence that the thicknesses calculated should come *at all* within the range of those giving rise to Newton's colours

Hinshelwood remarks that successive oxidations and reductions of a copper surface led to an intensification of the film colours produced, and to a correspondingly greater rate of fixation of the oxygen. He showed that the amounts of oxygen required to form films of the above colours remained in constant ratio. The simplest explanation of these facts would appear to be that the treatment causes a roughening of the surface, whereby the effective area of the metal is increased If this should prove to be the case, it would provide a not unlikely explanation as to why the colour remains unaltered when the outermost surface is ground away

D H BANGHAM
J STAFFORD

Chemistry Department,
Manchester University,
December 12

Stonehenge: The supposed Blue Stone Trilithon.

I HAVE read with much interest the review which appeared in the issue of NATURE for November 1, headed "Archæology of Stonehenge," not only as a thoughtful criticism on my recently published work, but also as a valuable up-to-date addition to the literature on the subject

The matter of the supposed Blue Stone Trilithon is of some importance in regard to the design of Stonehenge It has been commonly supposed that the two cup-shaped hollows now to be seen in Stone No 150 may be mortise sockets, indicating that the stone had been the lintel of a miniature trilithon In my book I have discussed the subject in some detail, and have given references to authorities and a photograph of the stone The conclusion arrived at is that these cup-shaped hollows have nothing to do with the original design of Stonehenge, but may very likely have been mortars for grinding grain, formed, perhaps, by prehistoric squatters on the site long after the building of Stonehenge, when the structure was already in a partly ruinous condition

In reference to this the writer of the review remarks

> "The author is in error over a fallen foreign stone which figures in Plate 6, Fig 2, in supposing the two holes seen on it were made, after it had fallen, It is curved in the same way as are those of the outer circle, but in this one the curve is sharper, showing it belonged to something smaller The holes in the stone are equidistant from the ends and are dowel holes like those in the big lintels, and this stone may formerly have fitted over the terminal upright stones of the horseshoe"

As a matter of fact, the centres of the hollows in the stone are *not* "equidistant from the ends" The one towards the north is 2 ft 6 in from that end of the stone and the other is 1 ft 11 in from the farther end The distance centre to centre of the hollows is only 3 ft. 5 in., and if a drawing be made to scale showing two of the obelisk-shaped stones of the horseshoe at this distance apart (centres), with this supposed lintel on top, it will be seen that the two uprights would have to be not much more than a foot apart in the clear (instead of the normal clearance of four or five feet) The tail-end of the (supposed) lintel would moreover have a considerable unsymmetrical overhang beyond its upright Such an abnormal arrangement is of course possible, but from what we know of the work of the builders of Stonehenge it may be regarded as most improbable

An attempt to form a trilithon with this stone as lintel supported on two of the shapeless boulders of the blue stone circle would be found even more impracticable

It is to be noted, moreover, that the face in which the hollows appear is not even, and the hollows are askew with each other (see Fig 1) The stone has a considerable curvature which would unfit it for a place at the end of one of the straight limbs of the horseshoe This curvature is double (slightly S-shaped), and is merely the form of the original boulder. It is not dressed, and has therefore no significance

It will further be observed that among the blue stones remaining on the site there is no stone that has any sign of a tenon on its top, or which bears any indication that it may have been an upright for a

FIG. 1

trilithon—nor is there any other stone which has cup-shaped hollows like those on Stone No 150 All the blue stones (now remaining) are, moreover, exceedingly hard (diabase and rhyolite) and show no sign of weathering

On the evidence of the physical facts noted above, and from other considerations set forth in my work on Stonehenge, it may be regarded as extremely improbable that Stone No 150 could have been the lintel of a trilithon. It will, moreover, doubtless be agreed that if this stone had been dug up in the course of excavation on the site of a prehistoric village, the conclusion that the hollows were mortars for grinding grain would have been accepted as obvious

Mr Edward T Stevens, the eminent Wiltshire archæologist, writing on this subject in 1876, remarks as follows

> "The two cavities in the prostrate foreign stone are too far from the ends of this particular stone, and too close together, to justify one comparing it with the imposts of the outer circle or outer horseshoe No trace remains of either of the syenitic uprights upon which it rested. This stone, however, is quite as likely to have served for an altar as for an impost, and the cavities may have been intended to receive libations or offerings of some kind"

Stevens then goes on to describe similar stones found in Sweden known as "elf-stones," which are still held in superstitious veneration and receive offerings to ward off sickness. He adds "I venture to suggest, therefore, that some further attention be given to this subject, before we jump to the conclusion that this foreign block of stone was an impost" (Jottings on the Stonehenge Excursion, August 1876, pp. 133-138). E. HERBERT STONE.

The Retreat, Devizes.

The Word "Scientist" or its Substitute.

WHEN literary gents, like Sir Clifford Allbutt, Prof. D'Arcy Thompson and Sir Israel Gollancz, come forward in defence of *scientist* and Sir R. A. S. Paget, an expert in vocal sounds, in the most cold-blooded manner possible, says that he would *ist* everybody, it were time that we illiterate sciencers ranged ourselves solidly with Sir Ray Lankester, ever a defender of the faith, proclaiming that we will not have truck with the would-be debasers of lingual beauty.

If I had ever favoured the term—I hate it—I should cease from using it, if only after listening to the High Commissioner for Australia, at the Imperial College of Science (not yet Scientists) dinner, a few days ago. Replying for the guests, at the close of his speech, he referred to the story of two men talking together and one saying—"There will be nothing to laugh at fifty years hence." "What, will there be no scientists!" came the reply. Let us hope there will not be any. The story is a good exemplification of our form in the public eye.

The real men, those who do things—bakers, butchers, builders, boxers, grocers, even green-grocers—all have names ending in *er*. The terminal *ist* is reserved for theosophists, thaumaturgists, even for those who pretend to be but are not chemists, only bits of the same. So far, indeed, is objection taken to chemist that a wag among them has proposed to substitute *chemor*, not chemor-ist, be it noted. The German *chemiker* was long known as superior to the English *chemist*. Still, *er* has its weak side to some—I am told that, in New York, the undertaker seeks to be known as the mortician. The fact is, none of us likes his name.

The Oxford Dictionary, a mine of inspiration which is too little used, gives *Sciencer* and *Sciential*, both euphonious words. Of late, I have often used sciencer, and like it. Sciential has the authority of Keats and is less committal—it may even be applied not merely to the properly scientific but also to those who neither do nor make anything but merely talk and claim to be of the elect, though I should bar classical telepathists. As to Dr. Jeans, for whom solicitude is properly expressed, he may well be spoken of as a sciencer, if not reckoned with magicians all will devoutly pray that he be kept away especially from *ists* in the guise of psychists.

I write this without consulting my sons but believe they would all support me, though I have not gifted any one of them with a musical ear—one of them, however, was brought up under Sir Clifford Allbutt in days when he was the boldest of warriors in defence of our English tongue.

We shall do well to take notice that scientist is fast becoming a word of evil import in the public ear—as meaning one of the set of peculiar people who talk a language no fellow can understand. Some day, soon, perhaps, the call may come to label NATURE the Journal of Babel, the Dictionary will then give—Babel, the language of a sect devoted to an obscure practice known as science.

HENRY E. ARMSTRONG.

SCIENTISTS have hesitated to use the word "scientist," not because it is a hybrid (they are well used to hybrids), nor because it ends in a sibilant "-ist" (they are most of them "-ists," of one kind or another), nor because the word is appropriated by the unqualified (professors are inured to such treatment), nor yet because the word was originally used opprobriously (they are not really less courageous than Tories or Radicals), but because they were diffident. They feared to offend classical taste. No scientist ever puts his pen to paper without casting a fearful glance over his shoulder to see whether a classic should be looking on. You may reproach a classic with ignorance of science and he will plume himself with the compliment. But to suggest to a scientist that he is guilty of a classical lapse is more mortifying to him than to tell him he should have said "napkin" instead of "serviette." It is thus sheer nervousness which has prevented him from using a generic term as obvious and inevitable as is the word "artist." Now, thanks to you, the scientist is discovering, with something of the naiveté of M. Jourdain, that the classic never dreamt of objecting to the word and only wonders why there should be so much shyness about the use of it. J. W. WILLIAMSON.

Gray's Inn, W.C.1.

Anomalous Dispersion in the Field of X-Rays.

IN the course of an investigation with the purpose of getting more exact determinations of the wave-lengths of the X-ray spectra, we have carried out a comparison of the lattice-constants of the two crystals, calcite and gypsum. In order to find the best possible value of this fundamental relation, we used a series of different spectral-lines with wave-lengths varying from 0.7 up to 5.2 Å.U. The measurements of the relation are given graphically in Fig. 1, where the values of $\frac{d_1}{d_2} = \frac{\sin \phi_2}{\sin \phi_1}$ are plotted against the wave-lengths. As seen from the graph there are two

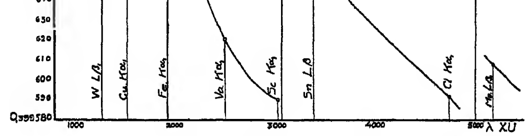

FIG. 1.

marked discontinuities in the run of the curve. It is also seen that these two abrupt variations coincide with the wave-lengths of the absorption-edges of calcium and sulphur.

It may be seen from the theory of X-ray reflection by crystals as given by Darwin and Ewald, that such an anomalous dispersion is to be expected. From these theories it is known that the simple Bragg law of reflection

$$n\lambda = 2d \sin \phi$$

is still valid if we give a modified meaning to the

constant d, that is, if d means, not the true distance d_0 between the reflecting planes but a corrected value

$$d = d_0\left[1 - \frac{4d_0^2}{n^2}\frac{\delta}{\lambda^2}\right],$$

where δ has the value known from the ordinary dispersion-theory

$$\delta = \frac{e^2}{2\pi c^2 m} \sum_{i=K, L, M} \frac{N_i}{\nu^2 - \nu_i^2},$$

and ν_i are the natural frequencies of the K, L, M, etc electrons

On passing one of the natural frequencies, the value of d apparently undergoes an abrupt variation quite in accordance with the experimental results

It may be noticed that the graph is not a simple dispersion-curve, as it gives the relation between *two* such curves, namely, that of gypsum to that of calcite The discontinuity at calcium is due to the fact that the relative number of the K-electrons of this element per unit volume is different at the two crystals

This result shows that it is necessary in all accurate measurements of X-ray wave-lengths to use a corrected Bragg formula for the calculation of the wave-lengths from the angles of reflections For this purpose, the first condition is to know the dispersion formula of the crystal for X-rays Such an investigation may be carried out with the ordinary prism-method applied for X-rays, as shown in a communication from this laboratory (*Die Naturwissenschaften*, December 26) or with the method given by Bergen Davis and his collaborators

ELIS HJALMAR
MANNE SIEGBAHN

Fysiska Institutionen,
Upsala Universitet,
December 12

Scattering and Absorption of γ-Rays.

IN a recent letter to NATURE (January 3, p 13) I have stated that, on current theories, it is exceedingly difficult to account for the results of experiments on the scattering and absorption of hard γ-rays. I should like to add to this statement that a reasonable explanation of such results has since been obtained by means of the following assumptions, for which there is a certain amount of evidence

1 The secondary β-rays produced in light elements by hard γ-rays are practically all recoil electrons

2 The photoelectric or fluorescent absorption coefficient of γ-rays varies as the cube of the wave-length.

3. The hard γ-rays of radium-C behave in the same manner as would a mixture of two types of wave-lengths 0 024 and 0 008 Å U. respectively, each type having about 50 per cent. of the total energy.

4 The number of quanta scattered per unit area at an angle θ varies as $(1 + \cos^2\theta)/(1 + 2\alpha)$, where $\alpha = h\nu_0/mc^2 = 0\ 0242/\lambda_0$, h being Planck's constant, ν_0 the initial frequency, m the mass of an electron, c the velocity of light, and λ_0 the initial wave-length.

With the angular distribution of "scattered" quanta proposed above, the average energy of a recoil electron, for values of $\alpha > 1$, approaches closely the maximum energy E_M which equals $2\alpha h\nu_0/(1 + 2\alpha)$ Further, as α increases, the total energy of the recoil electrons becomes a greater and greater proportion of the energy lost by the scattering process, *e g* when $\alpha = 3$, the total energy of the recoil electrons is equal to twice the energy of the scattered γ-radiation These are the reasons why one can account for the observed energy of the secondary β-rays when it is assumed that a large proportion of the total γ-ray energy is of the softer type, it being necessary to assume that this type is present in order to account for the observed values of the fluorescent absorption coefficient

It might be mentioned that, with distributions of scattered quanta hitherto proposed, the average energy of a recoil electron is about $\frac{1}{2}E_M$, and the total energy of the recoil electron is always less than that of the scattered γ-radiation

I believe it can be shown, from what has been proposed above, that γ-rays must have a "range", *i e* for rays of any one wave-length, there could be a certain thickness of material, through which the rays would not pass, no matter how great the initial intensity. This would indicate that the scattering of γ-rays is a scattering of "corpuscles," a view which I referred to and rejected in a former paper (*Phil Mag*, p 611, 1913)

In my letter of January 3, p 13, it is stated that, "Taking the average energy of such a β-ray to correspond to 467,000 volts, a simple calculation shows that only one in every five radium-D atoms emits a γ-ray on disintegration" The figures should have been 333,000 volts and only one in every seven radium-D atoms emits a γ-ray on disintegration.

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Spermatogenesis of *Succinea ovalis*, Say.

AN investigation of the spermatogenesis of *Succinea ovalis*, Say., a small terrestrial pulmonate of North America, has revealed the following .

1 Forty chromosomes are found in the spermatogonial divisions, and twenty in the maturation divisions

2 Typically of all pulmonates so far studied, there are two centrioles, proximal and distal Early in spermogenesis the proximal centriole penetrates through the nucleus of the spermatid, and with the surrounding intranuclear canal, forms an intranuclear rod in very much the same way as has been reported for certain prosobranchs.

3 Both the head and tail of the spermatozoon have a spiral twist These spirals go in either a clock-wise or counter clock-wise direction, one type being about as common as the other.

Of the cytoplasmic structures, the mitochondria and the Golgi apparatus were followed through all stages of spermatogenesis

The mitochondria are seen in the early primary spermatogonia as small masses of granules lying near the nuclei They increase in size and number in the primary spermatocytes, and at each of the maturation divisions they are distributed approximately equally between the daughter cells. Some of the granules go to form the sheath of the axial filament of the spermatozoon, while the rest are sloughed off with the cytoplasmic balls.

The Golgi rods cannot be identified with certainty in the primary spermatogonia In the primary spermatocytes they occur as conspicuous banana-shaped rods grouped closely around the idiosome, 15-20 rods can be counted in these stages. During dictyokinesis there is no fragmentation of individual rods, but they are distributed intact to the daughter cells 3-5 rods are found in the spermatids In the final ripening of the spermatozoon, the apparatus is seen in the cytoplasmic balls as faintly-staining, disintegrating bodies.

A more detailed account will be published later.

CLEVELAND P. HICKMAN.

Department of Biology,
Princeton University, U S A.,
November 26

Biographical Byways.[1]

By Sir Arthur Schuster, F R S.

3. Balfour Stewart (1828–1887).

If I were asked to name Balfour Stewart's outstanding quality as a scientific investigator, I should designate his absolute freedom from preconceived ideas both in the selection of his subjects and the manner in which he treated them He was fond of arguing by analogy or familiar illustration. According to the writer of his obituary notice in the Proceedings of the Royal Society, who knew him intimately, he was "full of the most weird and grotesque ideas" I cannot say that I ever became conscious of this in my own intercourse with him, but I only came into contact with him after his slow recovery from the injuries sustained in the Harrow railway accident of 1870 He was not a good lecturer and had difficulty in keeping order in the lecture-room—perhaps it would be more correct to say that he did not take the trouble to keep order, being too sympathetic with youthful exuberance In the laboratory he was an inspiring teacher, and it would not be an exaggeration to say that he was the godfather of much of our modern science, both Poynting and J J Thomson having received their first lessons in physics from him

Balfour Stewart's family intended him for a mercantile profession, and at the conclusion of his university studies he spent some time in Australia But science had laid its spell on him, and he soon returned to Edinburgh, where he became assistant to J. D Forbes, who had considerable influence in shaping his mental outlook It was during the six years he spent at Edinburgh that the work on the equilibrium of temperature radiation was begun and, in its essential features, completed. In 1859, Balfour Stewart was appointed superintendent of the Kew Observatory, which was then managed by a committee of the British Association under the presidency of P. Gassiot. All went well until the organisation of the meteorological service of the country was transferred from the Board of Trade to a committee of the Royal Society, consisting of eight Fellows, with General Sabine as chairman The expenses were covered by a Treasury grant of 10,000*l*

Trouble soon arose, and, I think, both for their historical interest and in justice to Balfour Stewart's memory, an account of the incidents which ultimately led to his retirement from the directorship of Kew Observatory should be given. I am enabled to do so on the evidence of the relevant documents, which came into my keeping after Balfour Stewart's death When the Board of Trade had agreed to the request of the Meteorological Committee for the assistance of a scientific secretary, Balfour Stewart was appointed to that office, understanding that he was to be the scientific adviser of the Committee, but when afterwards he was designated simply as "Secretary to the Committee" he disliked the omission of the qualifying word "scientific," but acquiesced. "Nevertheless," he declared in a printed statement from which I quote, "I continued to understand that it was my special duty, in case I might see anything defective in the scientific position of the Committee, to urge them to amend it."

Differences of opinion soon arose between Sabine and Stewart with regard to the method of reducing meteorological observations, and his repeated requests for clerical assistance were declined by the Committee The crisis came when Balfour Stewart directed General Sabine's attention to what he considered to be an error in an unconfirmed minute of one of the meetings of the Meteorological Committee Stewart's account of the interview which took place concludes with the following statement. "He [General Sabine] assured me there was no mistake and added in answer to a question that he, *on his own responsibility*, had authorised the preparation of such of those results at the central office as had not been authorised by the Committee." To use a familiar term, Sabine admitted having cooked the minutes At the same time, Balfour Stewart was privately told that the chairman was much opposed to his scheme of reducing observations, and that there was not much chance of its being adopted. With regard to the merits of the proposed scheme there can be little doubt Stewart had submitted it to a few independent men of science and the reply of the Astronomer-Royal, Sir George Airy, may be given *in extenso*

> "I have read with much satisfaction the paper of your Remarks on Meteorological Reductions, etc, especially with reference to Vapour I do hope that by going on thus you may make Meteorology a science of causation, and raise it from its present contemptible state
>
> "I have often thought that much may be gained by ascertaining at what rate aqueous vapour disseminates itself through air, and should long ago have made experiments, but that I want a hygrometer of sufficient delicacy I then thought of suggesting it to the Kew Committee Your paper restores the interest in my old intention, and I think I shall write to Mr Gassiot."

Lord Kelvin (then Sir William Thomson) also gave his full approval, writing

> "I believe the plan you propose is adapted to bring out information of the most valuable kind, from observations which, until reduced on some such plan, might be accumulated indefinitely without any practical benefit"

Stewart was naturally distressed by the manner in which his advice was set aside, no scientific grounds being given. Fearing that the anxieties of his office might affect his health, he wrote a letter to the chairman of the Committee resigning the secretaryship He also tendered to Mr. Gassiot his resignation as superintendent of Kew on the ground that the two bodies were closely bound together, but declared at a meeting of the Meteorological Committee that he gave up this office with extreme reluctance. He was asked, in an interview with Mr. Gassiot, whether there was anything that would induce him to withdraw his resignation, and was given to understand that Sabine would wait to hear the condition under which he would continue office before taking further steps. Stewart then wrote a letter explaining the difficulties

[1] Continued from p 57

in which he was placed owing to insufficient help in the numerical work and stating that, if some assistance were given him in the preparation of the preliminary reductions of the observations, he desired to withdraw his letters of resignation. The reply was as follows:

"I regret that you were so determined to send in your resignation It appears Sir Edward Sabine has written to Bombay, where Colonel Smythe is, and nothing can be done until the reply comes"

Sabine's letter referred to, offering the appointment to another man, was posted on the day of the interview with Gassiot, and—as Stewart points out—before his resignation had been formally accepted by the respective committees.

The obstinacy with which Sabine pressed his own opinion is perhaps intelligible in a man who was then eighty-one years old, but there is nothing to say in extenuation of the want of generosity exhibited in the following letter to Stewart.

"My not having responded to your request more promptly and more fully, has not arisen from want of solicitous thought, and wish to serve you

"I feel assured that if your work at Kew had ere now been crowned by the looked-for completion of the account of the results of the long and invaluable series of magnetic observations, the later and longer portion of which were under your own superintendence, you might, and I might, have appealed triumphantly to such an evidence, not only of what you were capable of doing, but of what you had done, as placing you in a pre-eminent position."

The letter is dated May 31, 1870, and was presumably written in answer to a request for a testimonial in view of Stewart's candidature for the chair of physics at Owens College, Manchester. With regard to the implied complaint, I have before me the copy of a letter written by Balfour Stewart, from which it appears that he was waiting, previous to 1865, for the details of the observations which were in Sabine's possession. In spite of his repeated requests they were never sent to him. He could scarcely be expected to start on an extensive work of reductions before he had the whole material before him.

Balfour Stewart's greatest scientific success was achieved in his researches on the equilibrium of radiation in an enclosure of uniform temperature, which led to the enunciation of the connexion between radiation and absorption. His omission to drive home convincingly the application of his results to the explanation of the dark Fraunhofer lines was, in his own later opinion, due to a want of chemical knowledge. Looking at a flame coloured with common salt, and believing that the yellow colour of the flame was due to luminous sodium chloride, he was disappointed to find that a plate of rock salt did not sensibly absorb the emitted light.

Stewart had the faculty of recognising the importance of problems, even when he had not the power theoretically or experimentally to make much headway in their solution. He saw, for example, the need of studying the temperature equilibrium in an enclosure which contained moving bodies, both radiation and absorption being affected by the Doppler effect. But instead of looking for the solution of the difficulty—as was subsequently done by Wien—in an adjustment of the law of radiation as depending on temperature and wave-lengths, he imagined that the equilibrium of radiation was actually destroyed, the second law of thermodynamics being satisfied by the mechanical forces necessary to maintain the motion In conjunction with Tait he designed an experiment in which a disc was kept rotating *in vacuo*, and believed he had actually discovered an increase of the temperature of the disc. The success of the experiment depended of course on the perfection of his vacuum, and Stewart shared the erroneous belief of the time that a perfect so-called chemical vacuum could be obtained by filling a vessel with carbonic acid, exhausting with an ordinary air pump and absorbing the remnant of the gas with caustic potash.

I have remarked that Stewart's mind worked a good deal by analogies He was fond of one particular illustration Imagining a moving train and a body of men cutting across by jumping into it from one side and out of it at the other, it is clear that the train will gradually lose speed The idea was applied to special cases and suggested several experiments to him I joined him in one of these, in which an electric current was passed through water and an electromotive force applied at right angles to the current Stewart hoped to detect some interference of the currents with each other. The same type of reasoning was in his mind in contemplating possible mechanical effects of radiation I believe that at the bottom of these speculations was some prophetic glimmering that a propagation of energy always implies a propagation of momentum The weak feature of his work was, that he often designed and tried experiments of a refined nature with appliances which were insufficient, and even at that time might have been improved upon—such were his attempts to discover a screening effect of metals on gravitation, or a change of mass by chemical combination. In the latter experiments, in which the combining bodies were mercury and iodine sealed up in a glass bottle, J. J. Thomson, who assisted him, nearly lost his eyesight through an explosion.

Stewart was indefatigable in his work. While the days were spent in the laboratory, he pursued his statistical investigations on magnetic and solar phenomena in the evenings Some of these researches are published under the joint names of himself, De la Rue and Loewy. The latter gentleman—though I believe he had some claim to scientific knowledge—was chiefly employed as an assistant, paid for carrying on the numerical work, which was often heavy I believe that De la Rue's share consisted in supplying the funds. One morning Stewart arrived at the laboratory in a great state of distress. In looking over the proofs of a paper accepted for the Philosophical Transactions, he had found that the numerical work was all wrong. Loewy had, in fact, saved himself trouble, and evolved the results out of his inner consciousness. The paper had to be withdrawn, and De la Rue paid a substantial sum for the expenses already incurred in printing Neumayer, who was at the time director of the "Sternwarte" at Hamburg and on whose recommendation Loewy had been engaged, told me afterwards that he had sent for Loewy and charged him with manipulating the results. Loewy admitted doing

this, but excused himself on the ground that, while he had originally worked honestly, Stewart had never checked his results, so that the blame must be his

Some reference should be made to a little volume, "The Unseen Universe," published in 1875, and intended to reconcile science with revealed religion It appeared anonymously at first and, though probably forgotten now, it created a sensation at the time, running rapidly through many editions, in the later ones of which the authors' names—Balfour Stewart and P. G Tait—were given Referring to Tait's contribution, Stewart told me that when he first approached him, suggesting a joint publication, his consent was subject to the condition that Stewart should write the book while he would make himself responsible for the preface When this was agreed to and the manuscript of the preface arrived, Stewart was amused to find that it was almost entirely taken up with an attack on John Tyndall, who was Tait's *bête noire* It had to be re-written, and to judge from internal evidence I should surmise that not much more than the first paragraph was Tait's work. I am under the impression, nevertheless, that Tait's share in the book was not neglible, and that though he acted mainly in an advisory capacity at first, he made substantial additions in the later editions.

Towards the close of his life Stewart became much interested in so-called spiritualistic phenomena, but he always insisted—sometimes with great vigour—on his disbelief in messages from the dead, which were contrary to his religious convictions. With regard to unexplained phenomena, in which fraud may possibly have a share, it must be said that Stewart's confiding nature rendered him quite unfit to act as a judge. He was like a child in these matters. A certain personage near Buxton—so far as my recollection goes, a clergyman—wrote to Stewart about his powers of second sight, which enabled him to find a hidden object or name a card drawn at random out of a pack. Stewart went to see him several times and was impressed. "What is most remarkable," he told me after the second or third visit, "is that the power can be transferred to others. There is a servant girl in the house who, after a stay of a few weeks, has acquired it and can now name an unseen card just as well as her master" Not a shadow of suspicion had crossed his mind.

Stewart's conversation was always suggestive and sometimes witty. The Principal of Owens College had a habit of writing letters to the professors when he had any fault to find. These always began with some complimentary remarks, the sting being reserved for the concluding sentence, or frequently a postscript. "Every billet has its bullet" was Stewart's comment after receiving one of these communications.

The Theory of Evolution since Darwin.[1]

By Prof E W. MACBRIDE, F.R.S

THE most recent development of the doctrine of evolution is the revival of Lamarckism—that is, the belief in the inheritable nature of the effects of use and disuse. Just as Bateson in 1894 enunciated the doctrine of the origin of species by sports long before this view was consecrated by the experimental labours of De Vries and given the name of the "mutation theory," so Eimer (1887) and Cope (1888) rebelled against the Weismannian conception of an unalterable germ plasm totally independent of the effects of the experiences of the body Eimer put forward the doctrine of orthogenesis This theory states that variations are the results of the effects of the environment on the complex constitution of the living organism, but that this constitution determines the character of these variations; they are not indefinite, but take place in a few definite directions Eimer, who chose for his special subject of observation the wall-lizard *Lacerta muralis*, and later the swallow-tailed butterflies, pointed out that new variations make their first appearance in the later stages of growth and become inherited earlier in life as the generations succeed one another A beautiful example, he explains, is afforded by the Ammonites, in which new features are first distinguishable in the outer coil of the shell, which is, of course, the youngest and latest to appear, whereas in succeeding strata the new feature is found affecting the more central coils. Thus it will be observed that Eimer draws the most decisive support for his theory from palæontology. Eimer seems to suppose that he is an opponent of Lamarck, but the only difference between them that I can discover is that Eimer seems to regard external conditions as altering the hereditary tendencies by direct action as sulphuric acid acts on metal, whereas Lamarck considers that external conditions stimulate an organism to make a response, and that it is this tendency to response that is inherited

Cope, in his book "The Origin of the Fittest," likewise advocates the inheritance of the effects of use and disuse, and relies on palæontological evidence to support his view. He points out that if the development of the Ungulates during the Tertiary period followed, we find evidence that the shocks and strains to which the leg bones were subjected, and which in moderation create enlargement and strengthening of those bones during the lifetime of the individual, gave rise, as generation succeeded to generation, to permanent thickenings, fusions, and elongations of these bones; and that the modifications in teeth can likewise be explained as reactions to the changing character of the food by which the Ungulata were supported. Cope's views have become increasingly prevalent amongst North American palæontologists, and are almost universally accepted by them to-day

The first great blow to Weismannism was delivered by the cytologists and experimental embryologists. The foundation stone of the "germ-plasm" theory was the fundamental distinction between body cells and germ cells, and the theory that, as development proceeded, the body cells were specialised so that each could only give rise to its special part of the body. But Driesch showed (1900) that if certain segmenting eggs were fragmented, a piece so small as one-eighth of the whole could give rise to a complete embryo, and Hertwig and Driesch further proved that the arrangement of these cells could

[1] Continued from p 55

be entirely altered by pressure, so that cells which normally gave rise to the front or back were displaced to the sides, and yet that perfectly typical embryos were formed. More exact methods of investigation showed that the structure of all the nuclei in the body was alike, so that each cell might be regarded as a potential germ cell, and that the differentiation of the organs of the body was not accompanied by a differentiation of the nuclei but was due to local changes in the protoplasm Therefore the same kind of nucleus—if the nucleus was to be regarded as the fount and director of life in the cell—must respond differently to different stimuli in different parts of the body

Previous supporters of Lamarckism had assumed the necessity of the inheritability of the effects of use and disuse in order to account for changes which could be shown to have occurred, but it was not until 1908 that definite experimental evidence was adduced to show that changes artificially induced had, as a matter of fact, been transmitted to posterity If this evidence were accepted, it was clear that the whole status of the questions must undergo a profound change, for a *vera causa* for the production of functional variations—in a word, of adaptations—would have been discovered We have seen that strong evidence has been brought forward to show that minute differences distinguishing brothers and sisters of the same family were not inheritable, while "mutations" or "sports" were strongly inherited. These sports are, however, invariably pathological or monstrous in character, and if they occurred in Nature would have no chance of surviving or propagating their like.

The evidence in favour of Lamarckism was based on experiments with salamanders and toads which were carried out in Vienna. There exist two kinds of salamander in Europe, and one of them gives rise to only two young which at birth resemble their mother The gilled fish-like larval stage with which the typical amphibian begins its free existence is in this salamander passed over within the womb of the mother The colour of the skin is black and the animal lives on the cool Alpine uplands—it is named *Salamandra atra* The other species of salamander is marked with bright yellow spots on a black background, it is an inhabitant of the lowlands and it gives birth to a considerable number (about thirty) of gilled young, which live for six months in the water before the gills drop off and the animals come on land. This species is named *Salamandra maculosa*. Now Dr. Kammerer, the investigator who performed these experiments, showed that if *Salamandra atra* was gradually accustomed to living in warmer and moister conditions, as reproductive period succeeded to reproductive period, it produced more young at an increasingly earlier period of development, and that when these young were reared to maturity and allowed to pair, the second generation gave rise to about half-a-dozen gilled young which took to the water and acted like the larvæ of *Salamandra maculosa*. Conversely, if *Salamandra maculosa* were made to live in comparatively cool and dry conditions, it began to carry its young for longer periods in the womb; fewer were produced at a birth, but these were born at a more advanced state of development. Finally, when these were reared to maturity and allowed to pair, the second generation gave rise to only two or three at a birth, and these were provided only with vestigial stumps of gills, so that they at once took up a terrestrial life.

If, again, the young of *Salamandra maculosa* just after metamorphosis were reared in cages the walls of which were painted yellow and black respectively, in those confined in yellow cages the yellow spots extended in area as the animal grew to maturity, so that after four years they were arranged in two conspicuous rows along the back If two such animals were allowed to mate and produce offspring, when the resulting generation grew to maturity under the same conditions as did their parents, the yellow extended to such an extent as almost to suppress the black pigment Those salamanders, on the contrary, which were reared in the black cages contracted the area of their yellow spots as they grew up, and when the second generation were reared under similar conditions, the animals became almost, if not quite, as black as *Salamandra atra* The full effect, therefore, required two generations exposed to the same conditions to show itself, and the second generation started, so to speak, where the parents left off If the offspring of salamanders which had been reared on a yellow background were reared on a black background, the yellow spots increased in area during the first six months of the animal's life, only after this period did the black begin to gain the predominance; in a word, the animal during the first period of its life *recapitulated* the history of the previous generation This experiment constitutes, so far as I can determine, the first experimental proof of the biogenetic law which has ever been made. When the offspring of salamanders which had been reared on a black background grew up on a yellow background a unique effect was produced the animals developed a single median stripe of yellow on the back This is a form which is practically never found in Nature and can only be produced by experiment

If we now turn to the experiments on toads, we may observe that nearly all toads, like the frogs, pair in water in the spring-time The male embraces the female with his forearms and keeps her firmly in his grasp for a considerable period—often for weeks—until she emits her spawn, which he then fertilises. In order to enable him to retain a firm hold of his partner's slippery body, he has developed under the index finger a horny pad covered with minute asperities, the so-called nuptial pad Now Alytes differs from all other toads in that pairing takes place on land, and as the female's body is comparatively dry and thorny the male does not require a nuptial pad in order to enable him to retain a hold on her The eggs are fewer and larger in size than are the eggs of other toads, but as in other species, they are emitted in a string connected together by a cord of jelly. The male winds these cords round his legs and remains encumbered with them until the young tadpoles hatch out, a curious habit which has earned for him the name of "midwife toad." The tadpoles of ordinary toads emerge from the egg provided with three feathery gills on each side, as they grow these gills become covered over with a fold of skin proceeding from the head, and the larvæ assume the familiar form of a rounded body and flattened tail characteristic of

the tadpole The tadpoles of Alytes, however, pass through the stage with external gills whilst still within the egg-shell and emerge only when the body has become, as in the later toad-tadpole, rounded and plump Whilst in the egg-shell they have only *one* external gill on each side

Now Kammerer showed that although Alytes normally lived in cool spots, it could be induced to live at a warm temperature if it were provided with a basin of water in which to lave itself In these circumstances, however, the male and female paired in water, and the eggs slipped off the legs of the male and lay in the water By taking special precautions to keep the water aseptic, some of these were hatched and the resulting tadpoles reared to maturity The next generation reared under similar conditions produced more numerous eggs which were smaller than those of the normal Alytes Out of these eggs the tadpoles hatched in the external gill stage with one external gill on each side In the next generation reared under similar conditions the tadpoles were provided with three external gills on each side as in ordinary toads, and in this generation the males developed horny pads

These experiments aroused a quite different kind of criticism from that which had been evoked by any previous work, and one which strongly recalled the "odium theologicum" with which the first presentation of Darwin's theory of evolution was received in 1859. The experiments were admitted to be conclusive if true, but some critics declined to accept them Kammerer visited England less than two years ago, bringing with him critical specimens, amongst them salamanders with a median stripe of yellow and a male Alytes showing the horny pad. Even then the critics were not convinced. It was asserted that the pad in the normal frog or toad was on the upper side of the hand and not on the lower side, and that therefore the specimen produced had not a true horny pad. In answer to this Kammerer asserted that in his Alytes—as his critics would have seen if they had examined it carefully—the nuptial pad was developed on the dorsal surface of the fingers but extended also round to their palmar surfaces; and to this answer I can add that the first four male frogs which I examined after this discussion all showed the pad on the lower surface of the hand as well as on the upper But Kammerer showed other specimens on the same occasion which reduced all the discussion on the subject of the pad of Alytes to the level of "straining at a gnat and swallowing a camel" For all critics and supporters of Lamarckism alike admit that Alytes is descended from ancestors which, like more normal toads, possessed pads, and that the appearance of a pad in Alytes is therefore an atavism

The most wonderful experiment, however, which Kammerer has ever published was that in which, *in one generation*, he had induced the blind cave-newt Proteus to develop a fully-formed eye These creatures he brought with him to England, and there was no possibility of mistake about the matter. Proteus cannot be confounded with anything else, its pale flesh colour and reduced limbs are characteristic, and newts of this kind with large well-formed eyes were shown at the discussion. One is inclined to ask whether it is easier to produce a fully-formed eye than a mere cornification of the skin

Kammerer's results have in the meantime been confirmed by the independent work of Durkhen on the colour of the pupæ of white butterflies This work was carried out in the University of Breslau, and was published in 1923. The pupæ of this species normally have an opaque skin of a greyish-white colour, but in a small percentage (about 4 per cent.) this colour is absent and the skin is transparent, and so the pupa appears green, owing to the green blood shining through If, however, the caterpillars are exposed to orange light, the formation of the white pigment of the pupa is largely inhibited, and the proportion of green pupæ rises to 65 per cent If these pupæ are allowed to develop into adults and produce offspring and the caterpillars of the second generation are exposed to the same conditions, then the proportion of green pupæ rises to 95 per cent ; if the caterpillars of this generation are, however, left in ordinary daylight, the proportion of green pupæ diminishes, but is still 34 per cent as compared with 4 per cent. in the controls Here, as in Kammerer's experiments, we see that the reaction to the environment on the part of the first generation affects the second generation, and that a trace of it persists even when the second generation is replaced in the original conditions

In England, Dr. Heslop Harrison, of the University of Durham, has observed that a certain melanic variety of moth is found where the food plants are infected with manganese salts derived from the smoke of adjacent factories He fed the pale variety of this moth on food impregnated with the salts of manganese, and after several generations succeeded in obtaining melanic specimens, and from these he obtained a melanic progeny which bred true.

We are, therefore, in a position to state that after the lapse of the first quarter of the twentieth century, the doctrine of Lamarck has been submitted to the crucial test of experiment and proved to be true. Now evidence of the actual course of evolution is derived from three classes of facts, namely, those of systematic zoology (*i e* the mutual relations of varieties and species), those derived from a study of embryology, and, finally, those deduced from palæontology or the study of fossils, and systematists, palæontologists, and embryologists alike have been forced to the conclusion that the effects of habits must be inherited in order to account for the facts which they find in Nature. We are therefore justified in saying that habit, which is the reaction of the animal to its environment, has been the great factor in evolution, and that the splitting of the original stock into divergent species has been due to different members of the same stock under the stress of different environments adopting different habits. Prof McDougall in "Psychology" has shown that this readiness to adopt new habits is a universal characteristic of living beings "An animal when its activity is roused by a stimulus," writes McDougall, "pursues an end, and its activity continues till that end is attained or until it is exhausted If it fails to attain that end in one way, *it will endeavour to gain it in another* until it achieves success." In this sentence, we venture to think, is contained the key to the riddle of evolution.

We might leave the subject here, but considering the vogue that the mutation theory of evolution has had, it is proper to consider whether any definite cause for these mutations can be found, and if so, what relation this cause bears to the reactions which set up habits.

Nothing has been more remarkable than the consensus of opinion of the upholders of the mutation theory that mutations are due to "chance," and yet, as Huxley remarked, one had hoped that a belief in chance had been finally exploded. Quite recently, however, a physiological cause for mutations has been suggested by Tornier, and much evidence in favour of it has been collected by him. The special subject of his investigations was the goldfish The most bizarre races of this creature have appeared, and these races when crossed produce offspring which obey the Mendelian rules. Now Tornier showed that the races of goldfish had been derived from a small species of carp which inhabits the rivers of China. He found that the Chinese breeders kept their stock in small dark jars under insanitary conditions in which they were scantily supplied with oxygen. Much of the spawn died, and among the survivors all sorts of abnormalities turned up; from these the most striking specimens were selected and used to found the new breeds. These facts suggested to Tornier the view that the cause of the mutations was the weakening of the developmental energy of the germ by the abstraction of oxygen during an early and critical period of development.

Tornier showed that this weakening had two consequences: (1) it made the embryo sluggish in its movements; and (2) it diminished its power of regulation of the various processes on the harmonious co-operation of which the upbuilding of the body depends. Thus enormous fins were produced by the swelling of the yolk in consequence of undue absorption of water underneath the skin-area from which the fin developed, telescopic protruding eyes by the engorgement of the growing eyeball with water, and so on. By treating the eggs of newts and toads in such a way as partly to suffocate them for a short period after fertilisation, similar embryos were produced Independently of Tornier, Jansen had arrived at a similar explanation of the cause of human deformities, the part played by the pressure of the swollen yolk in the goldfish's egg being assumed in the human embryo by the pressure of a too closely adherent amnion. What is inherited is, according to Tornier, not a factor or gene for an enlarged fin or protruding eye, etc., *but a certain grade of germ-weakness which in each succeeding generation produces the same morphological effects*.

If this view is correct—and all the evidence available conspires to show that it is—then mutations can have played no part whatever in evolution Since they are the outward and visible signs of a weakened constitution, they are in a state of Nature ruthlessly weeded out by natural selection Nevertheless they, like functional adaptations, are the result of the action of the environment—only in their case the animal has *failed to respond* to the changed conditions, whereas evolution depends on cases where the animal *has successfully responded* In the last resort, therefore, like Darwin we come back to natural selection, only what is "selected" is not a chance variation or peculiarity but the constitutionally vigorous individual with ability of self-adaptation, what is rejected is the individual of weakened constitution.

Obituary.

Sir William E. Garstin, G C M G, G B.E

SIR WILLIAM GARSTIN, whose death at the age of seventy-five occurred on January 8, commenced his career in India in 1872 as an officer of the Public Works Department, after studying engineering at King's College, London Thirteen years later he was invited by Sir Colin Scott Moncrieff, who had just taken charge of the Public Works Ministry in Egypt, to make one of the small group of Indian engineers who were undertaking the reorganisation of the irrigation system of Egypt, which was at that time in complete disorder.

In charge of the Circle of Irrigation which included the eastern half of the Nile Delta, Garstin spent seven arduous years in effecting his share of the restoration of the irrigation system, and then, on the retirement of Col Justin Ross in 1892, he was appointed Inspector-General of Irrigation for the whole country A few months later, on the retirement of Sir Colin Scott Moncrieff, he became Under-Secretary of State in the Ministry of Public Works

At that time the irrigation system was being rapidly improved, the basin irrigation of Upper Egypt had been largely remodelled by Col Ross, improvements in the Delta had led to large increases of crops, and larger supplies of water in the early summer were urgently required. Plans for a reservoir in or near the Nile Valley were being studied, and it fell to Sir William Garstin to advise on the scheme to be adopted As a result, the Aswan Dam with subsidiary barrages at Assiut and Zifta were built, and by these means, and later developments of them, Egypt's low-stage water supply was assured.

As soon as Omdurman had fallen and the Sudan had been retaken, Garstin took prompt measures for the clearing of the Bahr el Jebel and the Bahr el Ghazel from the "sudd"—those blocks of drift and growing vegetation which had closed many of the channels Sir William visited the Sudan on numerous occasions, and especially in 1901, and again in 1903, when he traversed Uganda also to see the headwaters of the Nile system The investigations and surveys which were then initiated have since furnished a mass of hydrographical information of the highest value both to Egypt and to the Sudan.

Although his work in relation to irrigation is the most known in Great Britain, Garstin's position as the senior officer of the Ministry of Public Works in Egypt brought him in contact with many other forms of the public service. On his recommendation a geological reconnaissance of Egyptian territory was started in 1896, which soon developed into the present Geological Survey. The Survey of Egypt commenced in the Ministry of Public Works while he was in charge, and

he warmly supported the various scientific activities which grew up in connexion with it

The Department of Antiquities has always formed a part of the same Ministry, and in its work and its responsibilities Garstin always took a keen interest As soon as the Aswan Dam was decided upon, entailing the partial submergence of the island and temples of Philæ, he took measures for the complete underpinning of all parts of the buildings which were not founded on rock, and later, when the raising of the Dam became necessary, he obtained the allocation of a considerable sum for the execution of an archæological survey of that portion of the Nile Valley which would be submerged. The present Museum at Cairo is also due to his efforts to house safely the ever-increasing collections of Egypt's ancient civilisation

A keen sportsman, the wild fauna of the Sudan strongly attracted Sir William Garstin, from its inception he strongly supported and took an active interest in the Zoological Gardens at Giza

H G L

WE are indebted to *Science* of November 28 for the following details of the life and work of Prof W A Locy, professor of zoology in Northwestern University, Illinois, who died on October 9 at the age of sixty-seven William Albert Locy was born at Troy, Michigan, of Dutch ancestry, and received his early training in the University of Michigan During the year 1884–85 he held a fellowship at Harvard, where he completed an embryological investigation on "The Development of *Agelena nævia*" In 1887 he went as professor of biology to Lake Forest University, where he remained nine years. During this period he published important papers on the embryonic development of the elasmobranchs, the derivation of the pineal eye, and the structure and development of the vertebrate head In 1896 Locy succeeded Prof E. G Conklin at Northwestern University, where he remained until his death His work there had two aspects; one, the developmental history of the sense organs, to some extent a continuation of his earlier researches, the other, the history of biological science. In 1908 he published a collection of historical portraits entitled "Biology and its Makers," which has since been translated into German, while in 1918 he produced "Main Currents in Zoology," and at the time of his death he was completing another work, "The Rise of Biology." The significance of his work on the history of science was recognised by his election as the first president of the History of Science Section of the American Association He was also president in 1915 of the American Society of Zoologists

WE regret to record the death, at the age of sixty-seven, of Prof J. Bergonié, professor at the clinic for medical electricity and biological physics in the University of Bordeaux Prof Bergonié was chiefly known for his work on electro-therapy He was the author of numerous papers, and was for many years editor of the *Archives d'Électricité médicale*, in which journal most of his original publications appeared. Among the most important of his original contributions to medicine we may mention "Contributions à l'étude du phénomène physique du muscle" and "Physique du physiologiste et de l'étudiant en médecine" (1892) Prof Bergonié invented an ingenious device for localising metallic foreign bodies in the human subject, which was used to some extent in the War. He also invented an apparatus designed to treat the condition of obesity. He died as a result of injuries associated with X-rays and radium During the last few years he had been actively at work upon the anti-cancer centre at the Hôpital St André, Bordeaux He twice received the gold medal of the Carnegie Foundation.

IN the issue of the *Physikalische Zeitschrift* for November 15, Prof. E Warburg gives a sympathetic account of the life and scientific work of his former assistant and colleague, Karl Richard von Koch, who died a short time ago after having resigned the professorship of physics at the Stuttgart Technical School in 1919 owing to heart trouble Prof Koch was born at Stettin in 1852, and after studying at Bonn, Freiburg and Gottingen, graduated Ph D at Freiburg in 1875 While librarian there he commenced research in physics under Warburg, and was appointed lecturer in physics in 1881 and extra professor in 1886 In 1888 he became professor at the Aachen, and in 1891 at the Stuttgart Technical School Here he designed the new Physical Institute, opened in 1910, which has since served as a model of what such an institute should be His scientific work lay mainly in the direction of improving methods of measurement, especially in elasticity, but he took great interest in the application of physical principles to practical problems and to natural phenomena His best-known researches are probably those on the elasticity of metals at high temperatures, on the determination of gravity, and on the auroræ

WE regret to announce the following deaths·

Prof S A. Beach, professor of agriculture at Iowa State College, who was known for his work on apple growing and whose name is included in the list of honorary and corresponding members of the Royal Horticultural Society, on November 2, aged sixty-four

Mr Alfred H Brooks, for twenty years chief of the Alaskan Division of the United States Geological Survey, on November 21, aged fifty-three

Dr E Hedinger, professor of pathological anatomy and histology in the University of Zurich, and formerly of the University of Basle, who, in 1914, undertook a special mission to South Africa to investigate trypanosomiasis in cattle, on December 24, aged forty-eight.

Dr Theodore Hough, dean of the medical department and for seventeen years professor of physiology in the University of Virginia, who worked on the factors regulating breathing and on related subjects, aged fifty-nine

Mr A H Savage Landor, well known as a traveller and explorer in Tibet and China and also in South America, on December 26

Mr F. G Newton, director of the Egypt Exploration Society's excavations in Egypt, on December 25, aged forty-six.

Dr B R G Russell, of the Imperial Cancer Research Fund, who made noteworthy contributions to our knowledge of tumour transplantation and of the respiration and carbohydrate metabolism of normal and cancerous tissue, on December 22, aged forty-four

Current Topics and Events.

In the *Times* of November 14 a special correspondent in Berlin, dealing with the disarmament of Germany, stated that the German intention "to increase the frightfulness of war by new methods" was finding "its expression in the creation of a great laboratory attached to the Kaiser Wilhelm Institute near Berlin, the object of which is to study war from the scientific point of view" "This mysterious, powerfully equipped, and strongly financed laboratory," it was added, "works in close contact with several parallel institutions scattered over Germany, and especially with the Gas Testing Institute in Hanover." This allegation has been met by a letter from Dr. H Freundlich, the Deputy Director of the Kaiser Wilhelm Institute, refused, he states, by the *Times*, and so published in the *Berliner Tageblatt* of December 16 Dr Freundlich states, in the most explicit terms, that neither in the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry, nor in any other Institute associated with the Kaiser Wilhelm Society, is there any work in progress that has the purpose of developing war from the scientific point of view, and that all work there undertaken is exclusively scientific and technical investigation for the industries of peace, and having nothing to do with the purposes of war Finally, Dr Freundlich invites the correspondent of the *Times*, accompanied by any expert he may choose, to visit the Kaiser Wilhelm Institute, so that he may investigate fully the situation and the character and purpose of the work which is being there carried out. We cannot, of course, know the considerations which led the *Times* to decline to publish this very emphatic repudiation of a serious charge, yet it seems highly desirable that the invitation of the Deputy Director of the Institute should be accepted, and the results made known in Great Britain. What can be credited to our late enemies should be credited, and if there could be an assurance that the great Institute, which was, and is still, presided over by Dr Haber, is now entirely detached from scientific work relating to warfare, it would be welcome news to all who are waiting for additional signs of a real regeneration of Germany in heart as well as in economic prosperity

It is unfortunate that the mere mention of the word atom in a scientific lecture to which reporters are admitted now usually leads to sensational statements in the daily press, much to the annoyance of the lecturer and the detriment of scientific truth. This happened last week in connexion with a lecture delivered at the University of Leeds by Prof R Whiddington during a meeting of the Science Masters' Association The lecture consisted merely of a general account of the present position of atomic physics with special reference to the work of Rutherford and Bohr Prof Whiddington's allusions to his own work were made to indicate the lines along which investigation into X-ray electrons and vacuum discharges was being attempted in the University of Leeds, and to give those members of the audience who so wished, an opportunity of seeing the kind of apparatus used It is scarcely necessary to say that no extravagant claims of the kind suggested in a London newspaper were put forward by Prof. Whiddington or implied in what he said, and the most charitable explanation of the fantastic account published is that the reporter could not sufficiently well comprehend a lecture delivered to an audience consisting mainly of university graduates in science

The following presidents and recorders have been appointed for the meeting of the British Association to be held at Southampton on August 26-September 2: *Section A* (Mathematics and Physics)—President. Dr G C Simpson, Recorder Prof A M Tyndall, University, Bristol *Section B* (Chemistry)—President Prof C H Desch, Recorder Dr H McCombie, King's College, Cambridge *Section C* (Geology)—President Dr W G Miller, Recorder Prof W T Gordon, King's College, Strand, W C 2 *Section D* (Zoology)—President Mr C Tate Regan, Recorder Mr F Balfour Browne, Dysart House, Luard Rd., Cambridge *Section E* (Geography)—President Mr A R. Hinks, Recorder Dr R N Rudmose Brown, University, Sheffield *Section F* (Economic Science and Statistics)—President (not yet appointed), Recorder Prof. H M Hallsworth. *Section G* (Engineering)—President Sir Archibald Denny, Bart, Recorder: Prof F C Lea, University, Sheffield *Section H* (Anthropology)—President Dr T. Ashby; Recorder Prof H J Fleure, University College, Aberystwyth. *Section I* (Physiology)—President Prof A V Hill, Recorder Dr J H Burn, Felden Close, Boxmoor *Section J* (Psychology)—President. Prof C Spearman, Recorder: Dr Ll Wynn Jones, 7 St Mary's Avenue, Harrogate. *Section K* (Botany)—President Prof J Lloyd Williams, Recorder Mr F T Brooks, 31 Tenison Avenue, Cambridge *Section L* (Educational Science)—President. Dr W W. Vaughan, Recorder Mr C E Browne, Christ's Hospital, West Horsham *Section M* (Agriculture)—President Dr J B Orr, Recorder Mr C G T. Morison, School of Rural Economy, Oxford

Of the many recent efforts made by British manufacturers to establish a home industry in the production of colouring matters, one of the most successful has been the enterprise started under the wise inspiration of Mr James Morton, of the Morton Sundour Fabrics, Ltd, of Carlisle Until 1914, this firm was entirely a dye-using undertaking dependent on continental sources for its supply of fast dyes The stoppage of German supplies of colours consequent on the outbreak of war led Mr Morton to turn his attention to the production of these essential dyestuffs, and, gathering together a group of chemists, he encouraged them to work out the difficult problem attendant on the large-scale production of modern vat colours, a group of chemical substances having highly complicated constitutions By the end of 1915, the intricacies of indanthrene blue and flavanthrene (indanthrene yellow) had been unravelled,

and these colours were being turned out on a manufacturing scale Other dyes of the same class speedily followed These persevering investigations were not, however, restricted to the imitation of foreign products The chemists of the Sundour factory, with commendable initiative, extended the scope of their work to the search for entirely new colouring matters Here again they achieved a noteworthy success in the discovery of a new group of dyes, known as the Caledon Jade-green series, for the typical representative of this group is unsurpassed for fastness and colouring power

A FURTHER important development is now announced from Scottish Dyes, Ltd, an offshoot of the Sundour firm Processes have been discovered for rendering soluble the anthraquinone vat colours, in this way overcoming one of the disadvantages attending the use of these insoluble dyes The process is being applied particularly to Caledon Jade-green, and the improved product is known as Soledon Jade-green Similar soluble colouring matters can be obtained from other vat dyes of the anthraquinone series and render it possible to apply these colours to cotton and wool equally In the case of the latter textile, this application will lead to a marked increase in the fastness of dyed woollen fabrics The above-mentioned developments taken in conjunction with the industrial success which has crowned the recent investigations of chemists in other British colour factories demonstrate conclusively that scientific research is not merely a necessary but a profitable form of expenditure in all commercial undertakings dealing with chemical products

AMONG the activities of the League of Nations, which celebrated its fifth anniversary on Saturday, January 10, are several of particular interest to workers in pure and applied science The Transit Organisation of the League is engaged in work on matters concerning road traffic, inland and maritime navigation, telegraph, telephone and wireless facilities, calendar reform, etc In the past year the Health Organisation has, in the words of the Fifth Assembly, " extended its sphere of action, improved, completed and defined its technical equipment, and is thus carrying out with increasing success its special task, which is to give effective help to the various national administrations in their campaign against epidemics and their attempts to improve public health " The Committee on Intellectual Co-operation, to which Prof Einstein has returned, and M Lugones, a distinguished Argentine *savant*, has been added, is organising and developing its work on bibliography, exchange of publications, inter-university relations, and the pooling and distribution of scientific information This Committee held an extraordinary session in Paris on Monday, January 12, under the presidency of M. Henri Bergson (France) Prof. Gilbert Murray represented Great Britain, and other members of the Committee include Prof Einstein (Germany), Mme. Curie (Poland), M Jules Destrée (Belgium), Sir J C Bose (India), and Prof R A Millikan (U.S.A) The principal item on the agenda was the question of the organisation of the International Institute for Intellectual Co-operation, which was recently offered to the League by the French Government. The proposed Institute, which is to be established in Paris, will be under the direction of the International League Committee in Geneva, and it will be the duty of this Committee to draw up such rules and regulations for its organisation as will safeguard the international character of the Institute

THE British Broadcasting Company's new high-power station 5XX is being constructed at Daventry, Northamptonshire The site of the new station is in open country, about 600 feet above sea-level, and 400 feet higher than the surrounding land A " T " aerial will be used, and an 800-foot and a 500-foot mast are being erected, the transmitter being situated directly under the centre The antenna has been designed so that its natural wave-length should be about 1600 metres, which is to be the wave-length used for transmission The power rating is nominally 25 kilowatts, but the actual power used at the station will be 100 kilowatts The earth system consists of a circular metal plate laid underground and has a radius of 100 feet It will be connected with the London studio 2LO by means of an overhead telephone line, but an emergency underground cable will also be installed It is expected that good crystal reception will be obtained up to a radius of about 100 miles Transmissions will take place in the afternoon and evening. Special programmes of its own will be provided two days of the week, a relayed provincial programme on a third day, and relays of the London programme for the remainder of the week The first programme will take place in a few months' time

IT is evident that the visit of the Parliamentary Commission to East Africa, referred to in our leading article of January 10, has had some effect in directing the attention of the colonial governments to the cause of scientific research. By a happy coincidence, while Major A G Church was making a plea for greater encouragement for scientific institutions at the St. Andrew's Dinner at Mombasa, the Governor of Kenya Colony, Sir Robert Coryndon, at the corresponding function in the capital, made the same appeal and made use of the same illustration, namely, the Amani Institute He stated that Kenya Colony is much behind the times so far as scientific research is concerned, and particularly in the investigation of human and animal disease, in botany and in ethnology, and there is lack of co-ordination amongst the East African Colonies on such questions Sir Robert said that scientific workers in Kenya are too few, that they are working under very difficult conditions, and he would welcome the establishment of a central laboratory in which scientific problems could be properly attacked. Regarding the Amani Institute of Tanganyika, he deplored the fact that nothing has been done since the War to develop the work begun by the Germans, and upon which many thousands of pounds was spent by them. In paying

a tribute to the work of Dr van Someren, who was responsible for the building and the collections of the Natural History Museum of Nairobi, the Governor made an appeal for the support of public-spirited men for the upkeep and improvement of that institution, laying stress on the fact that the cultural aspects of life must play an increasingly important part in the affairs of Kenya Colony

A PARTY of 32 undergraduates from the Engineering Departments of the University of Cape Town are at present on a tour in England Accompanied by eight members of the staff, including Profs Bohle, Plant, McMillan, Snape, and Boyd, they arrived in London on December 31, and their stay will extend over five or six weeks The objects of the tour are to bring the students into close touch with British manufacturers and to give them a broader outlook on life in general. The whole trip has to be completed within the long summer vacation The first fortnight has been spent in the London district, where, in addition to visiting the historic buildings, special visits have been made to the National Physical Laboratory, Science Museum, Woolwich Arsenal, and to some important firms From London the party proceeds to Birmingham, Manchester, Preston, Liverpool, Newcastle, and Sheffield Each student has to submit a report of the tour which, if the professor of mechanical engineering considers satisfactory, will count in lieu of the six weeks' vacation workshop course usually taken in the summer Many of the students from Cape Town after finishing their four years' course come to England for experience in works, and remain here While there are a fair number of openings for civil engineers in the Public Works and Irrigation Department of the Union Government, it is more difficult for electrical and mechanical engineers to find employment in the colony. In organising this unique tour, the Dean of the Faculty of Engineering, Prof H Bohle, has been assisted by the staff of the High Commissioner of the Union of South Africa and the officials of the Union Castle Mail Steamship Company, and as a result it has been possible to carry out the complete trip, lasting twelve weeks, for 65*l.* a head

THE disappearance of seals of economic value from their more accessible breeding-places, under the pressure of the seal-hunter, has intensified their destruction in more remote areas From some of these they have already been exterminated—the fur-seals (*Arctocephalus australis*) and sea-elephants (*Macrorhinus leoninus*) of Gough Island have all but gone—and there is a danger that in their other southern haunts such seals and the less valuable Weddell, crab-eating, and Ross's seals of the Antarctic circle may ultimately be reduced to the vanishing point We therefore welcome the announcement (*Times*, January 6) that the French Government has decided to create a preserve for seals and for penguins, which are destroyed wholesale in some areas for their feathers and oil, on the territories belonging to France in the Southern Ocean These include Kerguelen, the Crozet Archipelago, St. Paul and Amsterdam islands, and the Adélie Land sector of the Antarctic continent In these areas the destruction of seals and penguins will henceforth be illegal The crux of the efficacy of animal sanctuaries, however, lies in the proper enforcement of the law, and we doubt whether the policing of these widely scattered scheduled areas by naval patrols based on Madagascar, as is proposed, will be so thorough as one could wish to see

EVERY one familiar with astronomical and other optical instruments will see with regret the announcement that the old-established firm of Sir Howard Grubb and Sons, Ltd, St Albans, and formerly of Dublin, has gone into voluntary liquidation, and is for sale The business was founded in Dublin early in the nineteenth century by Sir Howard Grubb's father, the late Mr Thomas Grubb, F R S, who was engineer to the Bank of Ireland and designed and constructed the machinery for the manufacture of the bank notes Although made seventy or eighty years ago, this machinery was still in use four or five years ago and probably is so still A number of machine tools, such as lathes, planing, engraving, wheelcutting and dividing machines, were made by the firm, as well as many portrait lenses The works were moved from Dublin to St. Albans in 1918 in connexion with the manufacture of periscopes for British submarines Among the important astronomical instruments made by the firm are the following 27-inch refractor and dome for Vienna, 26-inch photographic refractor for Greenwich, 24-inch photographic refractor with 18-inch guiding telescope for Cape Town; and a similar instrument for the Radcliffe Observatory, Oxford, with dome and rising floor, 26-inch refractor for Johannesburg, mounting for 24-inch refractor for Santiago, Chile, 40-inch reflector for Simeis, Crimea, 7-metre solar spectrograph for Pulkovo, the 13-inch photo telescopes with 10-inch guiders for the International Photographic Survey of the heavens, erected at Greenwich, Oxford, Dublin, Cork, Capetown, Mississippi, Melbourne, Tacubaya (Mexico), Perth (W A), etc It is greatly to be deplored that a firm with such a record of splendid work, and a reputation so high among optical instrument manufacturers, should have lacked sufficient support to keep it in existence as a profitable concern.

THE late Prof John Milne, the distinguished seismologist, was among those commemorated a few days ago in a ceremony at Tokyo in honour of living and dead foreign benefactors of Japan

A SERIES of six Hunterian lectures on "Recent Discoveries of Fossil Man" will be delivered by Sir Arthur Keith at the Royal College of Surgeons of England on January 19, 21, 23, 26, 28, and 30, at 5 o'clock each day

THE Council of the Geological Society has this year made the following awards —*Wollaston Medal* Mr G W Lamplugh, *Murchison Medal*. Dr. H. H. Thomas, *Lyell Medal*· Mr J F N Green, *Bigsby Medal* Mr C W Knight; *Wollaston Fund*. Dr A Brammall, *Murchison Fund*. Dr. A. E Trueman, *Lyell Fund*. Dr J A Thomson and Dr. W A. Richardson

WITH reference to the note in our issue of January 10, p 60, on the proposed motor tours across the western Sahara to Timbuctoo, organised by Citroen Cars, Limited, it is announced that as absolute security cannot be relied upon along the Colomb-Bechar—Timbuctoo route, the opening of the service between the two points has been suspended for a period of at least one year

APPLICATIONS are invited by the Metropolitan Asylums Board for the two following appointments, namely, the directorship of the board's pathological services and that of their diphtheria antitoxin establishment Particulars of the appointments and forms of application can be obtained from the Clerk of the Board, Victoria Embankment, E C 4 The completed forms must be received not later than the morning of Wednesday, January 28

APPLICATIONS are invited for the post of an assistant agricultural chemist for the Division of Research, Lands and Forests Department, Sierra Leone Candidates must hold an honours degree in natural science (chemistry being the principal subject), or associateship of the Institute of Chemistry, and a diploma in agriculture Further particulars and the form of application are obtainable from the Private Secretary (Appointments), Colonial Office, Downing Street, S W 1

MR RICHARD H BURNE has been awarded the Honorary Medal of the Royal College of Surgeons of England for "services rendered to the advance of biological knowledge" Mr Burne has greatly extended the Department of Comparative Physiological Anatomy in the Museum of the College, of which department he is the Curator The medal thus awarded, although founded in 1802, has been awarded only eleven times previously. The list of former recipients includes the names of Sir Richard Owen, Sir James Paget, Lord Lister, and of Sir R Havelock Charles

Our Astronomical Column.

THE SOLAR ECLIPSE OF JANUARY 24 —This eclipse cannot be regarded as of great importance for the study of solar physics, owing to the unfavourable season of the year, and the rather low altitude of the sun at all the land portions of the track of totality The eclipse derives some interest, however, from the populous regions which it traverses in Canada and the N E corner of the United States, including some outlying districts of New York

Efforts have been made to induce the general public to join in the observations, in particular, to note the exact duration of totality at numerous points close to the northern and southern limits This will enable the exact position of the lunar node to be determined, as Newcomb did from similar observations in England in 1715 Numerous observatories lie within the totality track, so that full advantage will be taken of any opportunities for useful work that weather conditions may afford The altitude is too small for study of the Einstein shift, which was, moreover, dealt with sufficiently in 1922

The eclipse has some interest in the British Isles from the fact that, after a barren interval of two centuries, there is a very near approach to totality at St Kilda in the Western Hebrides The sun's altitude is, however, insufficient for any useful work, and landing on St Kilda is generally difficult in winter There is a large eclipse throughout the British Isles, beginning about $14^h 45^m$, and greatest phase an hour later The magnitude reaches 0 94 at Glasgow, 0 82 in London

It would seem that the only observation of value that can be made in Britain is the careful timing of the first contact Dr Innes proposed a useful method of improving the determination by frequent measures of the distance between the cusps for the first minute or so If the projection method be employed, two observers can mark on the screen the positions of the North and South cusps at prearranged beats of the clock This method was found practicable at Greenwich in April 1921

WOLF'S COMETARY OBJECT OF DECEMBER 22 — Observations of this object on December 22, 23, 25, 26 are now to hand Dr A Kahrstedt, of Berlin-Dahlem, has deduced the following (still very uncertain) elliptical orbit from the first 3 positions (Copenhagen Circular, No 56)

T	1925 March 27 7308 G M T (new)
ω	219° 32′ 38 0″
Ω	264 47 14 8
i	14 47 11 3
ϕ	40 27 44 4
μ	319 231″
log a	0 69726
Period	11 12 years

The magnitude is estimated as 16 The approach to the sun will probably cause a slight brightening, but the distance from the earth is increasing The object will remain observable for some months

EPHEMERIS FOR GREENWICH MIDNIGHT.

	R A	N Decl
Jan 14 0	4^h $6 4^m$	20° 0′
22 0	4 10 2	18 38
30 0	4 16 4	17 29
Feb 7 0	4 25 0	16 31

The object is in Taurus, moving towards Aldebaran The elements have some resemblance to those of Faye's Comet, due at perihelion next September Identity, however, does not appear to be possible

INTERESTING GROUP OF MORNING STARS —Mr W F Denning writes "On the morning of Thursday, January 22, the south-eastern sky before sunrise will display the planets Mercury, Venus, and Jupiter, and the crescent of the moon in near companionship The picture will be a rare and interesting one, but it will not be easy to observe, for the planets involved will rise at about 6 h. 35 m, and this is only 1 h. 20 m before the sun They will be placed, therefore, very near the horizon, and will require a favourable atmosphere at low altitudes in order to be well seen If the observer occupies a position commanding a good open view of the south-east, and if weather conditions are good, there should not be much difficulty in detecting the various objects, though twilight will be strong The best time to look for them will be at about 7 A M or a little afterwards Of the planets, Venus will be the most brilliant, Jupiter being next, and Mercury last in the order of magnitude"

Research Items.

ARCHÆOLOGICAL EXPLORATION IN FLORIDA —Mr J Walter Fewkes has been able to take advantage of the commercial exploitation of Weeden Island, Tampa Bay, to explore the shell mounds, which were noted nearly half a century ago as a prominent feature of this part of Florida, but have now to a great extent disappeared owing to the use of their material for road metal In vol 76, No 13, of the Smithsonian Miscellaneous Collections, Mr Fewkes describes and figures remains found in a preliminary exploration on Weeden Island, which was mainly directed to the investigation of a mound which had been used as a cemetery The prehistoric aborigines appear to have lived principally on shell fish, but they also ate fish, game, and rodents, and, possibly, roots and fruits The mound exhibited three layers of stratification, one being modern In the upper of the two ancient strata, skulls and skeletons occur in numbers, and the implements and a finely decorated pottery point to a relationship with the prehistoric inhabitants of Northern Florida and Southern Georgia The lowest stratum contains objects belonging to an ancient people of Florida whose origin and affinities are obscure, but whose pottery suggests affinity with the archaic pre-Tainan Ciboney culture of Cuba and the similar early cultures of other West Indian Islands Whether it was autochthonous in both areas or an extension from one to the other is a question for future investigation.

CLASSIFICATION OF CONSCIOUSNESS —The presidential address to the Section of Psychiatry, Royal Society of Medicine, delivered by Dr C S Myers, has been printed in the *Lancet* of November 29 Dr Myers puts forward certain views and aspects, derived from a study of pure psychology, in the hope that they may prove interesting and suggestive to those working in the applied field of medical psychology He reviews some of the more fundamental problems of psychology, which have of recent years been less frequently considered than before the War, owing to the urgency of more practical problems Nevertheless it is wise at intervals to view the more abstract problems Dr Myers considers the conception of consciousness and discusses the difficulties involved in the usual classification into the three modes, namely, the cognitive, conative, and affective, and offers an alternative scheme He then outlines the part played by consciousness and shows that its function is to select both from alternative responses and alternative stimuli so as to maintain an environment—whether physical or mental—that shall be favourable, and to avoid one that is unfavourable For this to be possible, it is necessary that relatively small variations in the environment should differ in the reactions evoked He shows how the vague complex precedes the differentiated simple and the part played by the power of projection, *i e.* the ability of the self to regard its own change of states as something outside itself The reflex act is interpreted not as an original type out of which more complex forms of activity have evolved, but as a decadent form of mental activity Dr Myers concludes with a discussion of the relation of consciousness to the brain, and points out that the recent developments of physical science have rendered the difference between mind and matter a different problem from what it was a hundred years ago

THE BIOGENETIC LAW AND THE GYMNOSPERMS —The very characteristic and stimulating paper that Prof E C Jeffrey of Harvard read before Section K of the British Association at Toronto, and at Edmonton, is printed in *Science* (vol 60, No 1563, December 12, 1924), and will certainly arouse interest amongst European botanists, possibly provoking the retort courteous, from the European view-points so vigorously assailed To Prof Jeffrey, the higher plants provide excellent examples of the validity of the doctrine of recapitulation, their witness being free from the obscurities introduced by "larval forms" He cites particularly the normal leaf form to be found in seedling stages of xerophytic Cacti, Veronicas, etc, as also the typical leaves on seedlings of plants later armed only with phyllodes or phylloclades, and the prevalence of the typical evergreen needle upon the seedling conifer, although later these plants may be deciduous, as on larch, or bear leaves confluent with the surface of the stem, as on the arbor vitæ Prof Jeffrey then proceeds to discuss the anatomy of living and fossil forms amongst Gymnosperms, and thus finds evidence for three "working principles," namely, (1) recapitulation, (2) the doctrine of retention (instanced by conservative organs, namely, root and reproductive axis), (3) the doctrine of reversion as a result of injury In analysing the anatomical and fossil data along these lines, Prof Jeffrey fights over again the phyletic battle of Araucarian phylum versus Abietinean as competitors for ancient standing amongst Gymnosperms, and concludes once more that "when the dust of conflict has settled, it will probably appear that Ginkgo and Pinus stand side by side as the prototypes of Mesozoic gymnosperms of Cordaitean derivation It will then be realised that Agathis and Araucaria are aberrant extremes, which merely simulate Cordaites on the basis of extremes meeting but have no near affinity with them"

THE COOLING OF THE EARTH —In the Journal of the Washington Academy of Sciences for December 4, 1924, Leason H Adams, of the U S Geophysical Laboratory, presents a very welcome discussion of the distribution of temperature at moderate depths within the earth He adopts the method initiated by Holmes in 1915 of utilising the age of the earth as a known factor in the problem This makes it possible to determine the relative importance of the heat generated by radioactive disintegration, and thus to calculate the internal temperatures from an assumed initial molten state Cooling at first is controlled almost entirely by convection giving a thermal gradient of nearly 1° C per km Convection is gradually terminated either by crystallisation, leading to a gradient of 2 5° to 5° per km, or by increasing viscosity, leading to a gradient less easily calculable, but lying within the range 1° to 10° per km As a probable average, 4° per km is adopted for the final computations These are based on the assumption that below the outer 100 km the material produced by crystallisation-differentiation would be peridotite, a diabasic zone forming above, and finally a granitic layer The important principle is then established that on account of the great age of the earth (1600 million years), the temperatures at depths greater than 100 km are unaffected by any reasonable variation of the initial temperatures in the upper 100 km For the purpose of calculation, an initial surface temperature of 1200° C has commonly been adopted (*e g* by Holmes and Jeffreys), and it has been argued that, as the surface was probably of granitic composition, a much lower initial temperature would more accurately fit the conditions However, as the present temperatures depend on the original temperatures at considerable

depths, it is easily seen that 1200° C, far from being too high, is more probably too low The author takes 1400° C, the melting-point of peridotite, as the effective initial temperature, and gives a temperature curve down to 300 km, which is the best representation of the probable average thermal conditions under the continents yet available

THE PHOTOELECTRIC PRIMARY CURRENT IN CRYSTALS —A paper by Messrs B Gudden and R Pohl, in the *Zeitschrift fur Physik*, December 6, deals mainly with the positive portion of the photoelectric primary current which is produced by the action of light of long wave-lengths, or thermal molecular movements, on a crystal in which light of short wave-length has caused a flow of electrons to the anode, leaving the positive ions in their original positions in the lattice The effect has been studied in diamond, with light of a number of different wave-lengths produced by a monochromator, and it appears that wave-lengths of 630-660 $m\mu$ are most effective in producing it The optical absorption of diamond extends farther towards the red, when the disturbances in the lattice are increased by the positive charges which remain fixed in the lattice after the negative portion of the photoelectric primary current has passed The authors formerly regarded the primary current as being wholly due to this flow of electrons to the anode, but they now include the positive portion of the current in this term With blue light, for example, it is shown that part of the primary current is due to the flow of electrons, without inertia, and part to a shifting, step by step, of the resulting positive charges towards the cathode, due to thermal molecular movements These facilitate the passage of an electron from a neutral atom to the positive ion standing next to it on the side towards the anode It is probable that, so far as the conductivity mechanism is concerned, the photoelectric phenomenon can be dealt with in the same manner, not only in other crystals in the author's first group, with refractive indices more than two, but also in second group crystals, such as sodium chloride which has been treated with X-rays

MAGNETISM OF THE COILS OF MOVING COIL GALVANOMETERS —It has been known for many years that the magnetic properties of the materials used for the suspended systems of moving coil galvanometers have much to do with the troublesome "zero shift" which often greatly increases the labour of the observer The British Scientific Instrument Research Association (26 Russell Square, London, W C 1) has, therefore, done good work in publishing a careful investigation (price 6*s*) on this subject by Mr G Williamson The author finds that zero shifts can be divided into two kinds first, those due to temperature changes and, secondly, those following upon deflexions of the coil The first cause is due to variations in the elastic constants of the suspended strips The second cause is due to the permanent magnetism of the constituents of the coil The author makes an exhaustive study of this second cause He uses two methods of obtaining rough comparative estimates of the permanent magnetic properties of similar specimens In the first method, he magnetises the specimen by a known strong field and then measures the couple exerted on it by a weaker field perpendicular to the direction of magnetisation In the second method, he measures the zero shift of the specimen following on a deflexion in a known constant field He finds that all the materials forming the galvanometer coil—silver wire, wooden former, silk insulation, the mirror itself—showed permanent magnetism Of the resultant effect, 18 per cent was due to the wooden former, 33 per cent to the silk insulation, and the remaining 49 per cent was due to the silver wire, mirror, binding wires, etc Some of the effects due to the silver wire could be minimised by heating it in concentrated hydrochloric acid, and the ferro-magnetic effects due to the wooden formers could be diminished by exposing them to hydrochloric acid gas The silk insulation was much the most difficult to deal with It was found that the ratio of zero shift to sensitivity diminishes as the magnetic field (*i e* the sensitivity) increases

BEESWAX —The production, properties and uses of beeswax are described in the *Chemical Trade Journal* for December 12, 1924 Beeswax is formed voluntarily by the bees loading their stomachs with honey and then resting in clusters perfectly still for twenty-four hours Owing to the introduction of artificial honeycombs in bee culture, European countries have failed to cope with the modern demand, and large quantities of wax are imported from Africa, the West Indies, and Portugal The imported material is mostly produced by wild bees and is inferior to the product obtained from the home-cultivated bee The wax is often bleached by exposure to the sun or ozone (extensively used at Leningrad) or by other oxidising agents The principal constituents are myricyl palmitate and cerotic acid, smaller quantities of myricyl and ceryl alcohols, psyllostearyl alcohol, melissic acid, many hydrocarbons (*e g* heptacosane hentreacontane) and unsaturated acids are also present The physical properties are described in detail, a table of constants being given

SYNTHETIC SWEETENING COMPOUNDS —The chemistry of synthetic sweetening compounds is reviewed by G M Dyson in the *Chemical Age* for December 6, 1924 The recent researches of Cohn and Holleman are described The introduction of halogen and other groups into saccharin has the following general effects The sweetness increases with decreasing molecular weight of the entering halogen group, though nearly all halogen derivatives have a bitter after-taste 6-Chlorosaccharin is more than half as sweet as saccharin itself, and is sweeter than the 4- and 5-chloro-derivatives Whereas 4-amino-saccharin is sweeter than saccharin, 4-nitrosaccharin is bitter The introduction of alkyl groups has little or no effect, though the after-taste is modified Multiplication of sweetening groups is not always associated with an increase of sweet taste Sternberg has pointed out that for an aliphatic compound to be sweet, the alkyl groups must not outnumber the hydroxyl groups by more than one, further, the sweetness of an aliphatic compound increases with the number of hydroxyl groups present. Oertly and Lyers have proposed a theory of taste akin to the colour and constitution theory, but the rules are more often broken than followed Mr Dyson describes in some detail the preparation of saccharin, and mention is made of "dulcin" and "methyl-dulcin," which are *p*-phenetyl urea and *p*-anisyl urea respectively

CONDUCTIVITIES OF ELECTROLYTES —Researches on measuring the conductivities of electrolytes by the induced magnetic field method of Guthrie and Boys have recently been carried out by O Scarpa (*Gazzetta Chimica Italiana*, November 1924) Adopting this method the author investigates the electrical resistance of, and the influence of a magnetic field on, an electrolyte in motion The action of a magnetic field on a jet of an electrolyte carrying a current is also described

The Physical and Optical Societies' Exhibition of Apparatus.

THE fifteenth annual exhibition of apparatus held by the Physical and Optical Societies at the Imperial College of Science and Technology, South Kensington, brought to light a larger number than usual of novel and improved instruments The standard of workmanship and finish was everywhere high, and it was a pleasure to note that the products of British firms, to which the exhibition was primarily devoted, compare very favourably in these respects as well as in ingenuity and soundness of design with imported goods of a similar character There was a preponderance of instruments for industrial purposes and for advanced research a certain number of firms also showed apparatus suitable for educational laboratories, but a greater proportion of apparatus of this type would be welcome at such an exhibition Special interest also attaches to disassembled instruments · a brass box with knobs is impressive rather than instructive

In briefly discussing some of the exhibits it is impossible to do justice to most of the stands, which could not be adequately studied in an exhibition lasting only two days It will be necessary to make an arbitrary selection of apparatus which appeared to be specially interesting on account of its novelty, and to pass over without mention a majority of items the intrinsic importance of which is at least as great

The most sensational feature of the exhibition was Mr C F Elwell's discourse on "Talking Motion Pictures," illustrated by demonstration films It must suffice here to remark that no one who saw and heard the demonstration can doubt that the essential problem has been solved, and that for better or worse the talking picture is ripe for commercial exploitation In addition to other items making for brighter physics, visitors had the piquant experience of being addressed by a very realistic President Coolidge on the American citizen's burden of taxation! An equally interesting discourse and demonstration was given each day by Mr F Twyman, who dealt with the Michelson interferometer In the hands of Mr Twyman and his assistant, this interferometer became a delicate means for studying temperature distribution in a transparent body the instrument was so adjusted as to project on the screen a field of substantially uniform colour derived from a source of white light, and on the introduction of the demonstrator's finger into one of the interfering light-beams, lines of colour appeared round the shadow of the finger, these lines representing approximately isothermal contours Perhaps the most striking of the experiments shown was the "soaking in" of the isothermal lines into a plate of glass when a match had been momentarily applied to the latter, and it was also made possible to "see" petrol vapour poured from a bottle and the lines of strain in glass under stress—the latter application giving effects similar to those which have been obtained by Prof E G Coker with polarised light

The Cambridge Instrument Company is one of the firms which enters into the spirit of the exhibition and seeks to enhance its interest by the variety of its exhibits and by admirable descriptions given in the programme The principal *métier* of the firm, the measurement of temperature, was represented by some dial thermometers of the vapour-pressure type, but they were somewhat overshadowed by more intriguing "side-lines" The dial thermometer appears to be displacing the glass thermometer from industry, for Negretti and Zambra also made a feature of thermometers in which a mercury bulb communicates with a dial-control through steel-lined tubing An interesting improvement in calorimetry is the use of stainless steel in a bomb calorimeter (Griffin) For taking the temperature of buried cables, Siemens measures the resistance of a nickel pilot wire fitted to the latter

Items of interest to meteorologists included an Assmann psychrometer ventilated by an electrically driven centrifugal fan, shown by Negretti and Zambra It is to be hoped that this or a similar firm will succeed in solving the hitherto unsolved problem of constructing a self-acting hygrometer with permanent zero apart from this latter consideration the firm's recording hair hygrometers appear to be fool-proof A simple and ingenious recording barometer of great sensibility (Hughes) is that designed by S G Starling the mercury bulb is connected to the vertical column of the barometer by a horizontal tube of substantial length, the whole being mounted on a pivoted board hanging in a vertical plane Movement of the mercury causes the board to tilt, while a pen carried by the board traces a record on a chronometric drum Short and Mason, by a special design of the linkwork controlling the pen of a barograph, are able to provide the latter with an exceptionally open scale A novel kind of cloud photograph is taken with the Robin Hill lens (Beck), which has an angle of 180°, so that a photograph of the whole sky can be taken on a single plate Such a photograph is of value in spite of its distortion, but if necessary a selected section of it can be straightened out by copying with the lens reversed

Two interesting oscillographs were those shown respectively by Tinsley and Co and by the Cambridge Instrument Co The former is of the inertia-less cathode-ray type and employs a hot cathode, high sensibility with low voltage being thus secured The cathode stream is focussed into a pencil by surrounding the filament with a positively charged sheath The Cambridge instrument, on the other hand, is an improvement on the Duddell oscillograph and enables simultaneous records to be obtained from three separate vibrators which are replaceable and may be electrostatic or electromagnetic in any combination Intense illumination is secured by applying a momentary excess voltage to the 4-volt metal filament lamp during and immediately before exposure of the travelling photographic film The Campbell frequency meter, which aroused much interest when it was recently described before the Physical Society, was also shown by this firm It depends on a bridge system employing mutual inductances, covers a range of from 200 to 4000 cycles, and attains an accuracy of about 1/10 per cent Other meters worth noting were a series for various quantities (ammeters, voltmeters, etc) but uniform exterior by the Weston Electrical Instrument Co These are of convenient square form but comparable in price with those of less portable design A very interesting detail of design has been introduced into the Cirscale moving-iron instruments (Record Electrical Co) in order to secure a pointer movement of 300° These instruments are of the type in which a pair of soft iron strips inside a solenoid are magnetised by the same field, so that the repulsion between them measures the energising current In the present instance, two pairs of such strips are used one member of the first pair is fixed, while the "fixed" member of the second pair is carried round by the moving member of the first pair, the two latter members being rigidly joined together but spaced apart along the axis of the solenoid The Rayworth's voltmeter (Elliott Bros) for testing accumulators is provided with a

differential winding and a cadmium electrode so arranged that, in addition to ordinary testing, comparison of the potential of each plate with that of the cadmium electrode can be carried out, and further, the unexpended charge remaining in the cell can be measured The Darimont electric batteries have the interesting feature that the exciting and depolarising solutions are separated by a semi-permeable membrane created by the reaction which takes place between the solutions themselves

For testing overhead A C mains, Crompton and Co provide a hinged-core transformer The ring-shaped core is passed over the main and closed so as to surround the latter, which then forms the primary of the transformer, while the winding on the core forms a secondary and enables the current in the main to be tested Impedance apparatus included the Duwatcon condenser for wireless (Dubilier Condenser Co), so designed that its range for series connexion slightly overlaps its range for parallel connexion, thus obviating the gap in tuning range which ordinarily occurs when the connexion is changed, and three interesting variometers Of these the Mansbridge is flat in shape and comprises D-shaped coils used alone it will cover all the B B C wave-lengths, and in conjunction with a fixed condenser of 0 002 μf will cover wave-lengths up to 1800 metres A similar range is attained in a variometer by the Marconiphone Co by means of a series-parallel switch In the "wound on air" variometers of the Igranic Electric Co the windings are spherical and entirely self-supported

Amongst wireless apparatus, the Multivibrator wavemeter designed by D W Dye (Sullivan) attracted much attention In this arrangement a specially constant tuning-fork, maintained in vibration by a thermionic valve, controls by accordance a multivibrator comprising two valves so cross-coupled as to generate oscillations rich in harmonics at approximately the same fundamental frequency as the fork By selective amplification, harmonics up to the 120th can be picked out and heterodyned with the oscillation the frequency of which is to be measured, and by using two such arrangements in series a harmonic of frequency $1 2 \times 10^6$ can be utilised A complete "public address system" for amplifying speech or gramophone reproductions was shown in action by Marconi's W T Co, high-power water-cooled valves as used for broadcast transmission by the M O Valve Co, and the newest types of dull-emitter and other valves by the latter, the Mullard Radio Valve Co, and Cossor A fool-proof emergency wireless transmitter for ships' lifeboats was shown by Evershed and Vignoles

As regards line telegraphy, it was gratifying to notice a column printer of British manufacture (Creed and Co) Morse line currents are converted to printed matter arranged in columns like that given by an ordinary typewriter, as in the American instruments which have hitherto held the field The direct-working sounder of the India Rubber, etc Works Co introduces the long overdue reform of replacing the pony sounder by a far more efficient device employing a diaphragm

A radium clock has been devised by Mr Harrison Glew the radium for which may be that contained in an ordinary applicator or other container which can be removed from the clock when desired in fact, the period of the clock may be used as a measure of the quantity of radium in any vessel to which it is connected An interesting high-voltage high-resistance battery useful in radio-active and ionisation work is the disc battery designed by Major C E S Phillips (Cambridge Instrument Co). It consists of adjacent paper discs coated with metal foil, is very portable, and is not damaged by short-circuiting The horrors of the dentist's chair may be shortened by the use of radiography in the apparatus provided by Watson and Sons all external high tension leads are eliminated for the benefit of dentists untrained in such matters, and for the peace of mind of their patients A Potter Bucky diaphragm is also provided for cutting out secondary radiation from the patient's body, which otherwise impairs the definition of the radiograph it consists of a grid of lead plates so arranged as to absorb radiation which deviates from the direct line, and it is kept in motion during exposure so that its shadow does not appear on the film

A soft-ray tube for crystal work, designed by Shearer, was shown by Hilger connected with a highly efficient evacuating arrangement This comprised a Hyvac backing pump (on the Gaede model but with optically perfect contact surfaces) in combination with a Vitreosil mercury condensation pump (Edwards and Co) with a fused silica casing, the over-all speed being about 200 c c per second and the ultimate vacuum about 0 000002 mm An even faster pump is the Kaye-Backhurst, which is all of metal and employs an *annular* jet of vapour from boiling mercury to entrap molecules diffusing from the evacuated space. The speed amounts to some thousands of cubic centimetres per second

Messrs Hilger also showed how to use a Lummer-Gehrcke plate in combination with a spectroscope to demonstrate the Zeeman effect, obtaining very clear definition Other optical items were a Nicol prism of 1⅛-in aperture (Bellingham and Stanley), a scaleometer (Ottway and Co) comprising a pocket microscope with a scale in the focal plane of the eyepiece and an oblique glass plate for illuminating the object, and a rod illuminator (Baker) for microscopes The latter very curious and effective device consists of a thick glass rod bent to any convenient shape and capable of carrying light by total internal reflection from a light source to a microscope in fact it forms a kind of hose for conveying light A selenium photometer (Watson and Sons), recently described by Dr Toy, has been specially designed for measuring the density of photographic negatives Two beams of light from the same source reach a selenium cell by different paths, and a screen can be turned so as to cut out one beam and let in the other at the same rate The negative is interposed in the path of one beam and an adjustable wedge in that of the other, so that when the opacities of these obstructions are equal, no change in the illumination of the selenium cell is produced by turning the screen

Teachers will be interested to find that kinematograph projectors for private use are coming within the reach of small pockets A Pathé projector (Baker) can now be obtained at a comparatively moderate price, while a more expensive outfit (Kodak) enables the user to take his own films as well as to project them, the films being reversed to positive without the use of a negative A Leitz photomicrograph (Ogilvy and Co) has been so arranged that all the operations necessary in photographing microscopic objects on a whole plate can be performed from a single position of the observer, and the apparatus is suspended on springs while the exposure is actually being made While discussing optical apparatus it is worth while to note that pointolite lamps can now be obtained for use on A.C mains.

A very simple planimeter shown by Harling consists of a single rigid piece of metal carrying a tracing point at one end and a hatchet-shaped projection, the plane of which passes through the point, at the

other The point is passed round a closed curve in the ordinary way, and the distance between the positions of the hatchet edge before and after this operation is a measure of the area encompassed It is claimed that this simple device can give an accuracy of 2 per cent

Surveying instruments included a tacheometer (Cooke, Troughton and Simms) in which the horizontal distance of a surveyor's vertical scale is given directly, allowance for the slope being made by an automatic cam-operated adjustment of the distance between the stadie lines in the focal plane of the eyepiece with which the image of the scale is compared Dr Hutchinson's goniometer (Swift and Son) was also worth noting on account of its versatility it serves as an ordinary goniometer, an axial angle apparatus, a Kolrausch total reflectometer, and a prism refractometer An ingenious balance (Oertling and Co) called the "Chainomatic" dispenses with all weights and riders below 0 1 gm by employing a chain attached at one end to an arm of the balance and at the other to a pillar which can be raised and lowered to a measured extent without opening the case The position of the pillar indicates how much of the weight of the chain is being borne by the balance arm In the tank gauge made by Negretti and Zambra for indicating liquid levels, air is pumped into a tube extending down into the liquid until it escapes from the bottom the tube is then put into communication with a pressure gauge which registers the head of liquid in the tank Another instrument of mechanical interest is the recording accelerometer of the Cambridge Instrument Co, in which an eccentric mass, the movements of which are made deadbeat by Foucault-current damping, records accelerations by the "stylus-on-celluloid" method developed by this firm

A fuller account of many of the exhibits will be found in the December issue of the *Journal of Scientific Instruments* published by the Institute of Physics. The issue is entirely devoted to the South Kensington exhibition

The following firms participated in the exhibition C. Baker (optical instruments), R and J Beck, Ltd (optical instruments), Bellingham and Stanley, Ltd (optical instruments), W Butcher and Sons, Ltd (the optiscope projection apparatus and the auto-print photographic enlarger), the Cambridge Instrument Co, Ltd (thermometric and various precision instruments), the Cambridge University Press, Carbic, Ltd. (the Otis King's calculator), the Chromoscope Co, Ltd (the mutochrome, for varying the colours in patterns and designs), Cooke, Troughton and Simms, Ltd (surveying instruments), A C Cossor, Ltd (thermionic valves), Creed and Co, Ltd (printing telegraphs), Crompton and Co, Ltd (electric laboratory apparatus), George Culver, Ltd (opticians' goods), J H Dallmeyer, Ltd (cameras and lenses), the Damard Lacquer Co, Ltd ("Formite" bakelite synthetic resin products for insulation, etc, the hardness of which is suggested by a humorist to have given rise to the company's name), Darimont Electric Batteries, Ltd, F Davidson and Co (optical instruments), the Dubilier Condenser Co (1921), Ltd (impedances), Edison Swan Electric Co, Ltd (pointolite lamps), W Edwards and Co, Ltd (vacuum pumps), Elliott Bros (London), Ltd (electrical testing apparatus), Everett, Edgecumbe and Co, Ltd (electric testing apparatus), Evershed and Vignoles, Ltd (electric tests, wireless, traction recorder for electric trains), Foster Instrument Co (pyrometers), E B Fry, Ltd (time measuring and lantern slides), A Gallenkamp and Co, Ltd (electric furnaces, etc), Gambrell Bros, Ltd (electric testing), F Harrison Glew (radio-active apparatus and cobalt steel magnets), John J Griffin and Sons, Ltd (potentiometers, etc), W H Harling (drawing instruments), Adam Hilger, Ltd (optical and spectrographic instruments), Henry Hughes and Son, Ltd (compasses, range-finder, etc), Igranic Electric Co, Ltd (wireless parts), the India Rubber, Gutta Percha and Telegraph Works Co, Ltd (telegraph apparatus), Geo Kent, Ltd (air, gas and steam meters), Kodak, Ltd (cameras, etc), H K Lewis and Co, Ltd (scientific publications), Macmillan and Co, Ltd (scientific publications), Marconi's Wireless Telegraph Co, Ltd, the M O Valve Co, Ltd (wireless valves), the Mullard Radio Valve Co, Ltd (Holweck molecular pump and valves), Nalder Bros and Thompson, Ltd (electric testing instruments, etc), Negretti and Zambra (meteorological instruments), Newton and Co (optical projectors), L Oertling, Ltd (balances and the Eotvos torsion balance), Ogilvy and Co (microscopes and accessories), W Ottway and Co, Ltd (surveying instruments, etc), Record Electrical Co, Ltd (switchboard apparatus), Ross, Ltd (optical and photographic instruments), Short and Mason, Ltd (meteorological instruments), Siemens Bros and Co, Ltd (electric thermometry), H W Sullivan, Ltd (high frequency, cable and other electric testing apparatus), J Swift and Son, Ltd (industrial microscopes, etc), H Tinsley and Co (electric testing, etc, apparatus), Watson and Sons (Electro-Medical), Ltd (X-ray apparatus), W Watson and Sons, Ltd (optical instruments), Weston Electrical Instrument Co, Ltd (electric testing apparatus), Wireless Press, Ltd, *The Wireless World and Radio Review*, Wray (Optical Works), Ltd (cameras, lenses, and the nephelometer for measuring opalescence), Zenith Manufacturing Co (resistances, etc)

Annual Meeting of the Science Masters' Association.

THE twenty-fifth annual meeting of the Science Masters' Association was held on January 5, 6, and 7 at the University of Leeds, at the kind invitation of the University authorities Members were housed at the University Hostels, an act of hospitality which was very much appreciated The fact that the meeting was held at Leeds gave those members residing in Scotland and the North of England an excellent opportunity of attending, and the number present was very large The meeting began with a dinner in the Refectory, at which the Association was entertained by the University Afterwards there was a reception in the Great Hall by the Vice-Chancellor, Dr J B Baillie, and the President of the Association, Sir Berkeley Moynihan, Bart, professor of clinical surgery in the University

After a delightful speech of welcome by the Vice-Chancellor, which was suitably acknowledged by the chairman of the Association, Mr E A Gardiner (Louth Grammar School), Sir Berkeley Moynihan delivered his presidential address The subject he chose was the debt which science owes to medicine, and was introduced by an historical survey of the progress of medicine from the earliest days to the present time Claiming that Hippocrates and Galen were the inventors of the inductive and deductive methods respectively in science, the president passed in rapid review the events of succeeding centuries and astonished his audience by showing how many eminent men of science had been physicians or surgeons Although, for several centuries, the growth of medicine scarcely kept pace with that of the slowest

of her intellectual children, the establishment of pathological anatomy at the hands of John Hunter and others, and, in more recent times, the great work of Lister, finally resulted in the reunion of the two methods of scientific inquiry—observation and experiment—so long divorced in medicine

After referring to the great difficulty in medicine of obtaining an accurate anamnesis, the president expressed his views on the nature of the help which might be expected from researches carried out in the laboratory He pointed out that discovery of the cause of a disease, though often extremely valuable, does not necessarily mean that we can immediately effect a cure, or even that we should be able to devise a more efficacious method of treatment Treatment of tuberculosis, for example, has been very little changed by the discovery and isolation of the tubercle bacillus In the same way, even if science solves the problem of the cause of cancer, it does not follow that that fell disease will at once become curable So far as cancer is concerned, indeed, Sir Berkeley said that we should never forget that we already know how to cure it in almost all parts of the body in which it commonly occurs Nothing in clinical practice is more certain than this—that cancer in the first instance is a local disease, and that, with few exceptions, an early operation for any cancerous growth is attended by only the slightest risk, if indeed by any, and may confidently be expected to confer a permanent immunity from a return of the disease

The chairman then called upon Prof A Smithells, past president of the Association, to move the vote of thanks Prof Smithells referred feelingly to the warm friendship which had existed for so long between the president and himself, and expressed the thanks of the Association in very happily chosen words The vote was seconded by Prof H. E Armstrong, who has been a staunch friend of the Association, no less than its tireless mentor, since its inception a quarter of a century ago The audience showed its appreciation of Sir Berkeley's address by carrying the vote with enthusiasm

Tuesday morning was devoted to the business meeting, and to lectures given to the Association by Profs J H Priestley, R Whiddington, and R W Whytlaw-Gray During the afternoon and evening, demonstrations were given in the laboratories by members of the University staff, and tours were made through the Departments of Textile Industries, Leather Industries, Colour Chemistry, and Engineering Members of the Association expressed great pleasure at the laboratory demonstrations, where they obtained many new ideas for their own courses at school Special mention must be accorded to the delightfully simple apparatus devised for showing the Brownian movement in tobacco smoke, which attracted a great deal of attention and requires nothing more elaborate than two good microscope objectives and a suitable source of light

On Wednesday there was a fruitful discussion on the connexion between science teaching in schools and universities, in which both sides were well represented The discussion was opened by Prof Smithells, who was followed by Dr Terry Thomas (Head Master of Leeds Grammar School), Mr F S Young, Mr Willings, Mr F B Stead (H M I), Prof W P Milne (University of Leeds), and others In the afternoon, excursions were made to the Leeds Forge, the Yorkshire Copper Works, the Yorkshire Iron and Coal Co, Ltd, the West Ardsley Collieries, Messrs Ackroyd and Best (glass-blowing), the Prospect Mills (spinning, weaving, dyeing, and finishing), and Messrs J Nicholson and Sons, Ltd (sulphuric acid works) The educational importance of these visits, which enabled members to realise more closely the relationship between science and industry, can scarcely be exaggerated, and thanks were expressed to the various firms for their kindness in receiving the Association

During the whole of the meeting there were excellent exhibitions of books, chemicals, and scientific apparatus by the leading firms, among which the exhibit by the local house of Reynolds and Branson may be specially noted There was also a stall devoted to books written by members of the Association, which testified to their literary activity A noteworthy feature was a list of books suitable for school science libraries, which should prove of great value to those engaged in teaching science in schools

It was announced that the Bishop of Birmingham had been asked, and had agreed, to act as president for the coming year

The meeting was one of the most successful in the history of the Association, and warm thanks were conveyed to the Vice-Chancellor and all other members of the University who had done so much to make the visit a memorable one Congratulations were also offered to the University on its recent jubilee celebrations

Automatic Telephony and Teletyping.[1]

IT may be doubted whether the present generation works harder than the last, but, at any rate, it works at a much higher speed, and all kinds of devices are used to accelerate its rate of working Whether this movement is altogether for the ultimate benefit of the human race is a moot question, but that it exists every one knows who has had experience of modern business methods The incentive is the increase of profits that comes from doing an increased volume of work in a given time, by the aid of machinery Speed and haste have very different meanings, and if the quality of the work does not suffer by the higher rate at which it is done, then the increase is beneficial, especially when it increases the time of the worker for exercise and recreation

Amongst the devices for speeding up business, automatic telephony and printing telegraphy, or teletyping, will play a prominent part in the future, It is perhaps not generally known that the work of converting the manually operated telephone system of London into an automatic switching system has already been started The task is a stupendous one, and it will take fifteen years to complete

The accuracy of the service given in any telephone exchange, whether manual or automatic, depends largely on the ability of subscribers to use the telephone properly The delays that occur at present are often due to a lack of clearness in articulating both the name of the exchange and the number, and to the congestion of traffic during the "busy hour" In an automatic, or, as the Americans more properly call it, a machine switching exchange, these difficulties do not arise, and if we make the probable assumption that a well-looked-after machine is more accurate than a human being, it seems certain that the machine switching system will give a better service than the manually operated system we have at present

During the progress of conversion a called subscriber will often be connected with a manually operated exchange The calling subscriber operates his instrument in the usual way, and the call passes to an operator at the manual exchange Fitted to the panel in front of this operator is a group of forty lamps divided into four sections of ten lamps each

[1] From the Presidential Address to the Junior Institution of Engineers, delivered by Dr. Alexander Russell on Wednesday, January 7

and each section is numbered from 1 to 10. When the number dialled by the calling subscriber is received by this apparatus, four lamps glow, one in each section, and the operator sees at a glance the number of the subscriber required. The calling subscriber does not speak, and the connexion is made with the same ease as if it were all automatic.

When two subscribers attempt to call another at the same time, one gets through and the other hears the engaged signal. But when a call is made through a manual exchange, and the operator finds the required line is engaged, the call is stored until the line is clear.

One great advantage of the machine switching system is that the service will be as good in the night time as during the day. Except for, possibly, one or two short periods at the rush hours, the highest grade of service will be given. Errors due to faulty articulation will be a thing of the past. It has to be remembered that the system adopted by the British Post Office is one that is capable of being continually improved. Although the mechanisms remain the same, the rapid expansion of the system may lead to changes in the methods of operation in the immediate future.

These great auto-exchanges, with thousands of movable contacts in continual operation, appear uncanny to the non-technical person, but telephone engineers regard them in the same way as we would look on a large indicator for electric bells. Seeing that there are now more than twenty million telephone exchange stations in the world, it is instructive to remember that the first was built less than fifty years ago. We can be quite certain that the next fifty years will show an equally marvellous progress.

Wonderful though automatic telephony is, electricians believe that in a few years' time it will have an equally wonderful rival in the new printing telegraphy. The "ticker" is well known in large business offices where the latest quotations are printed in a continuous stream on a strip of paper. The latest information is thus always available and can be acted on immediately. In the United States both the Western Union and the Bell Telephone Companies will shortly offer telegraph typewriter service to business men, and it seems highly probable that this will be a commercial success. It will lead to teletype telegraphy, in which automatic switching exchanges not unlike those used in automatic telephony are employed.

It is perfectly feasible with this system for an ordinary girl typist to send messages up to 5000 miles at a speed of at least 30 words a minute. The British Post Office has already teletypes in use on several long lines. As the method extends, machine switching stations will become a necessity and are certain to be employed. It looks as if, in a few years' time, every wealthy person will have a "ticker" line for news superposed on his telephone line, his radio set being reserved mainly for entertainment purposes.

At first sight it might be thought that an air mail service would be a great rival to teletype telegraphy, but this is not the case. The actual time of a letter by air mail to Paris is about four hours. It takes about 40 minutes to get from Charing Cross to Croydon Aerodrome. From Croydon to the Paris Aerodrome takes about 2½ hours, and from the aerodrome in Paris to the city another 30 minutes. Finally, we have to allow at least 20 minutes for posting and delivery. It would generally, therefore, take more than four hours. By the new telegraphy a long printed telegram could be received in 10 minutes. For distances greater than 50 miles the new printing telegraphy would probably be better than telephony.

A serious drawback to the use at present of teletyping is the cost of a cheap printer and of a trustworthy typewriter keyboard, but in a few years' time, it is possible that there may be such a demand for hundreds of thousands of them as would make them very considerably cheaper; they might then cost little more than an ordinary good quality typewriter. There would be a local rate for payment and, doubtless, also a time and distance rate.

University and Educational Intelligence.

LONDON.—A number of free public lectures have been arranged for the coming term. Among them are the following, the number of lectures in the case of a course being indicated in brackets, and the lecture hour being 5.30 unless otherwise stated:—

At University College.—Series of eight lectures beginning on January 27: Prof. G. Elliot Smith, on the evolution of man; Mr. W. J. Perry, on the beginnings of civilisation, and on the spread of culture; Dr. C. F. Sonntag, on man's place in Nature (2); Prof. J. E. G. de Montmorency, on the significance of the humanism of the negro races; Mr. Reginald A. Smith, on the Old Stone Age, and Mr. C. D. Forde, on the megalithic monuments of Brittany; Dr. A. S. Parkes, on the physiology of reproduction (6), beginning January 22 at 5 P.M.; Prof. A. V. Hill, on the physiology of muscle and nerve (12), beginning January 23, at 11 A.M.; Prof. T. B. Wood, on the nutrition of the young animal (3), beginning March 4; Prof. A. C. Seward, on a botanical topic (3), commencing March 17; Prof. H. Westergaard, University of Copenhagen, on vital statistics (2), commencing March 9; Mr. A. Gomme, on technical and scientific libraries, on February 18 (one of a series of five lectures on the use of libraries).

At King's College.—Dr. J. A. Hewitt, on carbohydrate metabolism (8), beginning January 19 at 5 P.M.; Prof. E. V. Appleton, on the rôle of the atmosphere in wireless telegraphy, on January 19; Mr. C. J. Gadd, on the excavations at Ur, on January 26; Mr. S. Smith, on the nature and influence of Babylonian literature, on February 9; series of three lectures on Chinese civilisation: Lieut.-Commdr. A. S. Elwell Sutton, general views (February 5); Prof. W. E. Soothill, China's contribution to Western civilisation (February 12); Dr. J. P. Bruce, education in China (February 19); Prof. A. E. Jolliffe, on English mathematics before Newton, on February 16; Prof. E. Prestage, on Vasco Da Gama and the discovery of the sea-route to India, on February 13; Prof. E. W. Scripture, experimental investigations of German poetry, on February 26.

At the Royal School of Mines, S. Kensington.—Prof. L. Denoel, University of Liège, on tubbing deep shafts and subsidence (4), beginning February 23; Prof. C. A. Edwards, on chemical combination in metallic alloys and its nature (4), beginning March 3.

St. Bartholomew's Hospital Medical College.—Prof. C. Lovatt Evans, on the physiology of plain muscle (4), which began on January 14.

APPLICATIONS are invited for the professorship of botany in the West of Scotland Agricultural College, 6 Blythswood Square, Glasgow, in succession to the late Prof. A. N. McAlpine. The latest date for the receipt of applications is February 15.

ADULT education has been provided for in the United States on a rapidly increasing scale since the War. This is due to several causes, one being anxiety on the part of the State universities to give through their extension divisions conspicuous evidence of their usefulness, another the emergence of an insistent demand "that those who live in America must understand America." In Bulletins, 1923, Nos. 30 and 31, of the United States Bureau of Education, detailed accounts

are given of measures recently taken for the Americanisation of adult immigrants, especially in California. It had become apparent that the very efficiency of the education given to their children in the common schools was undermining the control of the immigrant parents and disrupting their family life. "Under the roof of every immigrant home is going on a death struggle between two worlds, two cultures, two civilizations,—in the same family circle different tongues are spoken, different newspapers and books are read, different manners and customs observed, . . . a delicate network of precious traditions is (so it seems to the immigrant) being ruthlessly torn asunder, a whole world of ideals is crashing to ruin, and amid this desolation the father and mother picture themselves wandering about lonely in vain search of their lost children." To meet this situation, the State of California has provided for the employment of "home teachers" to work in the homes of the pupils of the common schools, giving instruction in sanitation, the English language, home economics, and the fundamental principles of the American system of government and the rights and duties of citizenship. It is clear from the report that these teachers, where carefully chosen, are doing extremely valuable work—such work, moreover, as is perhaps needed quite as much in other countries, including Great Britain, where aliens are numerous.

THERE is a marked contrast in the system of government, i.e. in the localisation of administrative power, between the universities of Australia and those of Great Britain and the United States. In the United States, the president, and in the British Isles the vice-chancellor (or principal), is the controlling and unifying force. The constitution of the University of Sydney provides that the Senate of 24 members, of whom not necessarily more than 5 need be members of the teaching staff, has the entire management of and superintendence over its affairs. It has hitherto out of its own body, annually, elected a chancellor and a vice-chancellor, the latter usually being a lawyer. Melbourne is governed by a Council of not more than 31 members, of whom less than one-third can be and less than one-quarter must be members of the teaching staff. The Professorial Board may forward to Council an opinion on any matter relating to the University, as may also Convocation, which consists of all graduates, but neither the Professorial Board nor Convocation has executive functions. The Council elects, annually, a chancellor and a vice-chancellor. For some time past the teaching members of the Australian universities have felt the need of a permanent chief. Sydney had already taken a step in that direction by appointing a warden when the Conference of Australian Universities in 1920 adopted the following resolution in favour of the establishment of an executive office analogous to that of principal or vice-chancellor of a British university :—"That it is desirable, for more effective working, and consonant with the general character of Australian Universities, that the appointment of an officer of high status, who could adequately represent both the administrative and the educational aspects of the University before other Universities and the public generally, be seriously considered." The Senate of Sydney has recently given effect to this resolution by converting the vice-chancellorship into a stipendiary administrative office. To this office, Dr. M. W. MacCallum, professor of modern literature for the period 1887–1920 and since 1920 emeritus professor, has been appointed as the first incumbent. Dr. MacCallum will shortly arrive in England for the purpose of delivering lectures by invitation of the British Academy.

Early Science at the Royal Society.

January 17, 1677/8. Dr. King instanced, that a gentleman who was a patient of his, could, two or three miles off London, discover when he entered into the smoke of London. Upon this some discourse arose about the reason why some chimnies smoke, that is, do not convey the smoke from the fire up the funnel, but suffer it to spread into the room.

January 18, 1664/5. Sir Robert Moray produced a discourse concerning coffee, written by Dr. Goddard at the King's command. Mr. Boyle mentioned, that he had been informed that the much drinking of coffee produced the palsy. The Bishop of Exeter seconded him. Mr. Graunt affirmed that he knew two gentlemen, great drinkers of coffee, very paralytical. Dr. Whistler suggested that it might be inquired whether the same persons took much tobacco.

1671/2. Mr. Newton's new telescope was examined and applauded.

January 20, 1663/4. The general and particular warrant to demand bodies for dissection, drawn up by Sir Anthony Morgan, was read and approved. [The president afterwards stated that a warrant had been issued for demanding a body for dissection, which was to be performed the day after the execution, in Gresham College, by Dr. Charleton, who had offered himself to open the muscles after a new method.]

1669/70. Mr. Hooke produced for examination two ways of making an universal measure. Many exceptions were made by divers members against both these ways. For these and like difficulties both these ways were laid aside.

January 21, 1662/3. Dr. Merret acquainted the society that he had received an information from Naples, concerning a person, who had an art of keeping new-born infants alive without respiration, for a good while. It was thought very desirable to have farther inquiry made.

1674/5. Sir John Bankes made a full report concerning the three fee-farm rents payable from fewes; concerning which the council accepted of the proposal, and resolved to dispose of the four hundred pounds legacy of the late Dr. Wilkins, bishop of Chester, for purchasing of them; and accordingly desired Mr. Hoskyns to take care of a legal conveyance of the same to the Royal Society and their successors.—Mr. Oldenburg mentioned, that the earl of Aylesbury being obliged to go out of town, could not take care of providing a lecture, as he thought to have done, and had therefore sent to him his forty shillings; which money was delivered to the treasurer.

January 22, 1661/2. The experiment of making marbled paper was made by a man introduced by the amanuensis; which succeeded according to Mr. Evelyn's description of that method.—The pendulum experiment was discoursed of by the lord viscount Brouncker, who brought in the account and schemes of it. His lordship's paper was ordered to be registered, and a copy of it made against the Friday following, and brought to Sir Robert Moray, to be sent to Mons. Huygens.

1673/4. Mr. Lister having formerly sent some of his blood-stanching liquor, with a desire, that trials might be made with it before the Society, it was ordered, that the operator should provide a dog against the next meeting for that purpose.

January 23, 1666/7. Mr. Hooke was ordered to bring in something in writing relating to the controversy between Mr. Hevelius and Mons. Auzout, which might impart, that upon examination of the observations made in England, and compared with those in other parts, the society was inclined to believe, that Mr. Hevelius had been mistaken.

Societies and Academies.

LONDON

Linnean Society, December 18.—E. J. **Collins**: The physiological aspect of the incidence of late blight (*Phytophthora infestans*) of potatoes. So far as the foliage is concerned, that of the early varieties of potato and those most susceptible to blight have the highest water content; the most resistant, which are the latest to mature, have the lowest water content. High water content induces rapid tuberisation, and this entails early maturation and susceptibility to blight. The nitrogen content of the foliage reaches a maximum and then falls more or less rapidly according to the growth period of the variety. Maturation is thus accompanied by a decreasing nitrogen content of the foliage. The water: nitrogen ratio increases during the season and in general is highest at the time of infection. The degree of susceptibility to blight is indicated more precisely by the value of this ratio. Young foliage has a lower water and higher nitrogen content than foliage of a medium age, while in old foliage the reverse conditions hold. Sprayed foliage shows a lower water and a higher nitrogen content than unsprayed foliage. The value of spraying, apart from the action of the copper solution as a fungicide, lies in its physiological effect, since those metabolic changes accompanying old age, and heightening susceptibility, are delayed.—R. B. **Seymour Sewell**: A study of the Andaman sea-basin. The Andaman Sea appears, originally, to have been formed during the Eocene epoch as a comparatively shallow brackish-water estuary, into which all the main rivers of Burma flowed, by the simultaneous upheaval of parallel mountain-ranges. At the close of the Miocene period a second upheaval, volcanic in character, caused the appearance of a mountain-chain that is now represented by Narcondam Island, Barren Island, and Invisible Bank. The present deep basin is due to extensive subsidence, probably in post-Tertiary times. Continued subsidence, or subaerial erosion followed by a rise of sea-level led to the formation of various channels permitting the entry into the basin of a shallow-water fauna derived from both the Indian and Pacific Oceans, and of a deep-water fauna derived from the Bay of Bengal.

PARIS

Academy of Sciences, December 8.—Paul Séjourné was elected a free academician in succession to the late Prince Bonaparte.—Pierre **Humbert**: The $V_{m,n}$ functions of Hermite with imaginary indices.—A. **Kovanko**: Suites of functions of class I (Baire).—Stanislas **Millot**: Some problems of Laplace. A discussion of some problems in the theory of probability.—E. **Paloque**: A new instrument for the determination of time and of latitude. This instrument is based on the observation of the simultaneous passage of two stars in the same azimuth.—Jean **Chazy**: The arrival in the solar system of a foreign star.—Charles **Henry**: A formula of the theory of relativity.—Jean **Granier**: The absorption of electromagnetic waves by ice. For the temperatures and frequencies studied, a condenser of pure ice may be represented by an arrangement of two condensers in parallel, one with an inductive capacity equal to 2.05, the other with an inductive capacity of about 78, the latter being in series with a resistance the value of which decreases as the temperature increases.—Félix-Joachim de **Wisniewski**: The doublets of the alkali metals.—P. **Job**: The electrometric study of hydrolysis.—A. **Boutaric** and G. **Corbet**: The critical temperature of solution of ternary mixtures. Curves are given showing the relation between critical solution temperatures of various ternary mixtures and their composition.—Jean **Thibaud**: The penetrating γ-radiation of mesothorium-2.—L. J. **Simon** and A. J. A. **Guillaumin**: Some derivatives of tetracetylmucic acid.—Léon **Piaux**: The spontaneous oxidation in alkaline solution of 1-methyluric and 1.3-methyluric acids. On oxidation in alkaline solution, 1-methyluric acid behaves similarly to uric acid, but 1.3-dimethyluric acid is completely split up, giving methylamine, potassium oxalurate and oxalate.—Georges **Patart**: The synthesis of methyl alcohol by reduction of carbon monoxide. A mixture of carbon monoxide (1 vol.) and hydrogen (1.5 to 2 vol.), under a pressure of 156 to 250 atmospheres, is circulated over a catalyst (zinc oxide) at a temperature between 400° and 420° C. On cooling to 20° C., a liquid is obtained containing water and methyl alcohol, with traces of impurities. Neither aldehyde nor acetone is present in this alcohol. The author considers that the commercial preparation of synthetic methyl alcohol by this method offers no serious difficulties.—Henri **Hubert**: Contribution to the study of the microseismic disturbances at Dakar (Senegal). The small earth vibrations at Dakar would appear to be mainly due to the impact of waves of the sea at points near this locality.—Ch. **Maurain**: The propagation of aerial waves as shown by the experiments at La Courtine. Two maps are given showing areas in which the velocity of propagation of the waves was that of the velocity of sound, and other areas in which the velocity was much lower than the velocity of sound: the latter are called zones of abnormal reception.—E. **Delcambre**: The meteorological work of the Jacques-Cartier service.—Ch. **Kilian** and R. G. **Werner**: Pure cultures of the fungi of lichens.—Mme. L. **Randoin**, J. **Alquier**, Mlles. **Asselin** and **Charles**: The nitrogenous materials of wheat offal. Comparative study of their biological value as factors of upkeep, of growth and of reproduction. Wheat offals (bran, etc.) regarded as a source of nitrogen have not the same biological value in a normal ration.—M. and Mme. G. **Villedieu**: The action of solutions of copper sulphate on mildew. Millardet in 1886 pointed out the toxic action of very dilute solutions (1 in 4,000,000) of copper sulphate on the mildew of the vine (*Plasmopara viticola*). The authors show that the copper sulphate was not really in solution, but was present as very fine flocculated precipitates of basic copper sulphate, removable by filtration. The toxic action is exerted by this insoluble basic copper sulphate.—A. **Malaquin**: The genital glands and primordial sexual cells in the annelid *Salmacina Dysteri*.—J. **Legendre**: Zoophilia in mosquitoes and its application to prophylaxy.—A. **Paillot**: A new disease of the caterpillars of *Pieris Brassicae*, and on diseases of the nucleus (of the blood corpuscles) in insects.—Ch. **Dhéré**, A. **Schneider** and Th. van der **Bom**: The fluorescence of some metallic compounds of hæmatoporphyrin. Details of the photographed fluorescence spectra of the compounds of hæmatoporphyrin with zinc, tin, lead and cadmium.—Albert **Dalcq**: A new method of experimental parthenogenesis and its application. The maturation, activation and segmentation of the egg of *Asterias glacialis* can be produced by a single solution: the segmentation of the virgin egg is the result of the specific effects of various cations.—C. **Dawydoff**: Reduction in *Lineus lacteus*.

CALCUTTA

Asiatic Society of Bengal, November 5.—S. H. **Lele**: Studies on Bombay fish. Revision of the genus Drepane (Cuv. and Val.). The anatomical

and morphological characters of the members of the genus Drepane are discussed In view of constant differences, the genus should be split up into two species, as was done by Cuvier and Valencinnes —B P **Uvarow** · Orthoptera (except Blattidæ) collected by Prof. Gregory's expedition to Yunnan. An account is given of the Yunnanese crickets and their allies collected by Prof Gregory. The fauna of the Yunnanese mountains is found to be palæarctic while that of the valleys is truly oriental —R **Hanitsch** Blattidæ collected by Prof Gregory's expedition to Yunnan Three species were found in Prof Gregory's collection, two of which are described as new to science —H **Hosten** (1) Zādoē, of St Thomas' Monastery in India (about A D 363) A short supplementary note to the author's recent study on St Thomas and San Thomé, Mylapore, in the Society's Journal, quoting a reference to St Thomas purporting to go back to the fourth century A D (2) A letter of Fr A de Andrada, S J (Tibet, August 29, 1627), and of Fr Gaspar Diaz, S J (Annam, 1627) Spanish texts, with English translations, and notes The letter by Diaz was published together with the other, probably in 1629, in two folio leaves, and a copy of the publication is in the British Museum De Andrada's letter is not known in its original Portuguese form Both give additional data concerning early European contact with Tibet and Further India (3) A letter of Father Francisco Godinho, S J, from Western Tibet (Tsaparang, August 16, 1626) This original French text adds to the data recently made available concerning early contact with Tibet through the efforts of the Roman Catholic missionaries in the beginning of the seventeenth century.—A S Ramanatha **Ayyar** A note on Arddhanārīśvara The identification proposed by Father H Hosten in his recent paper on St Thomas in the Society's Journal is criticised The figure there interpreted as the representation of an Amazon is in reality one of Arddhanārīśvara The theory of Egyptian influence at Mahābalipuram in the seventh century A D. is therefore rejected —M Hidayet **Hosain** The development of the Hadīth concordance in Arabic literature The traditional sayings attributed to the Prophet Muhammad form a body of literature ranking first in importance in Islamic theology after the study of the Quran itself The number of these sayings is overwhelmingly great, and from early times Muslim theologians have felt the need for the classification of them, and for a system to refer them to their sources The science of "locating" the traditions is called "'Ilm al-Atrāf," and the author traces the development of the literature expounding this science from A H 400 to the present day —'Abdul **Walī** Sketch of the life of Sarmad Sa'īd, surnamed Sarmad, a contemporary of Shah Jahan and Aurangzeb, was a Persian of Jewish birth He came to India and after much wandering settled at Delhi He was of a mystic temperament and embraced Islam, into which he introduced his mystic speculations On a charge of heresy he was beheaded by order of Aurangzeb

Official Publications Received.

Proceedings of the Eleventh Indian Science Congress (Bangalore, 1924) Pp xv+262 (Calcutta Asiatic Society of Bengal) 6 12 rupees

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan Vol 12, Part 2 Über den Einfluss meteorologischer Faktoren auf den Baumzuwachs (I) Uber den Einfluss auf den Stammumfang eines Tannenbaumes Von Hirokichi Nakashima Pp 69-263+plates 13-26 (Sapporo.)

Public Health Administration and the Natural History of Disease in Baltimore, Maryland, 1797-1920 By Dr William Travis Howard, Jr (Publication No 351) Pp vi+565+2 maps (Washington Carnegie Institution) 3 25 dollars

General and Physiological Features of the Vegetation of the more Arid Portions of Southern Africa, with Notes on Climatic Environment By William Austin Cannon (Publication No 354) Pp viii+159+31 plates (Washington Carnegie Institution) 2 50 dollars

Root Behavior and Crop Yield under Irrigation By Frank C Jean and John E Weaver (Publication No 357) Pp v+66+6 plates. (Washington Carnegie Institution) 1 25 dollars

Department of Agriculture, Straits Settlements and Federated Malay States Bulletin No 36 "Red Stripe" Weevil of Coconuts (*Rhynchophorus schach*, Oliv) By G H Corbett and D Ponniah Pp 51+6 plates (Kuala Lumpur) 50 cents

Department of Commerce U S Coast and Geodetic Survey Terrestrial Magnetism Serial No 268 Results of Magnetic Observations made by the United States Coast and Geodetic Survey in 1923 By Daniel L Hazard (Special Publication No 102) Pp 44 (Washington Government Printing Office) 10 cents

Proceedings of the Royal Society of Edinburgh, Session 1924–1925 Vol 45 Part 1, No 2 The Irreducible System of Concomitants of Two Double Binary (2,1) Forms By W Saddler Pp 3-13 Vol 45, Part 1, No 3 A Series Formula for the Roots of Algebraic and Transcendental Equations. By A. C Aitken Pp 14-22 Vol 45, Part 1, No 4 The Electrolysis of Salts of Alkyloxyacids By Dr David A Fairweather Pp 23-33 (Edinburgh R Grant and Son, London Williams and Norgate, Ltd) 1s each

Anuario del Observatorio de Madrid para 1925 Pp 477 (Madrid Instituto Geografico)

The Scientific Proceedings of the Royal Dublin Society Vol 17, N S, Nos 42-47, August 42 Experiments on the possible Effect of Vitamins on Quantity of Milk and Butter Fat, by E J Sheehy: 43 A Mechanical Device for Sealing off Radium Emanation Tubes, by Dr H H Poole, 44 Notes on the Filtration and other Errors in the Determination of the Hydrogen Ion Concentration of Soils, by Dr W R G Atkins, 45 Variations in the Permeability of Leaf-Cells, by Prof Henry H Dixon, 46 Notes on Acarine or Isle of Wight Bee Disease, by Lt-Col C Samman and Prof J Bronte Gatenby; 47. Note on a Physical Method of separating the Fats in Butter-fat, by Prof Felix E Hackett and T A Crowley Pp 333-368 4s Vol 18, N S, Nos 1-4, November 1 Seasonal Changes in the Water and Heleoplankton of Fresh-water Ponds, by W R G Atkins and G T Harris, 2 The Synthesis of Urea from Carbon Dioxide and Ammonia under Atmospheric Pressure (Part 1), by Dr Kenneth C Bailey, 3 Oogenesis in Lithobius forficatus, by S D King, 4 The Determination of the most Economic Size of Pipe line for Water power Installations, by H H Jeffcott Pp 48 5s (Dublin Royal Dublin Society, London Williams and Norgate, Ltd)

Department of Commerce Bureau of Standards Miscellaneous Publications No 58 Technical Conference of State Utility Commission Engineers, held at the Bureau of Standards, Washington, D C, March 2 and 3, 1923 Pp iii+80 (Washington Government Printing Office) 15 cents.

National Museum of Wales Seventeenth Annual Report, 1923-24, presented by the Council to the Court of Governors on the 24th October 1924 Pp 38+6 plates. (Cardiff)

City of Leicester Museum and Art Gallery. Twentieth Report to the City Council, 1st April 1912 to 31st March 1924 Pp. 66 (Leicester)

The National University of Ireland Calendar for the Year 1924. Pp viii+324+369+117 (Dublin)

Annuaire pour l'an 1925, publié par le Bureau des Longitudes Pp. viii+686+A71+B56+C71 (Paris Gauthier-Villars et Cie) 6 50 francs

The Pleistocene of the Middle Region of North America and its Vertebrated Animals By Oliver P Hay (Publication 322A.) Pp vii+385. (Washington Carnegie Institution) 2 50 dollars

City and County of Bristol The Bristol Museum and Art Gallery. Report of the Museum and Art Gallery Committee, for the Year ending 30th September 1924 Pp 20+8 plates (Bristol)

Ministry of the Interior, Egypt Department of Public Health Reports and Notes of the Public Health Laboratories, Cairo Ankylostomiasis and Bilharziasis, Cairo Pp iii+196 (Cairo Government Publications Office) 30 P T

Diary of Societies.

SATURDAY, JANUARY 17

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, St Thomas's Hospital), at 4 —R J S McDowall The Sensory Sympathetic Nerves. —J W Pickering and H Gordon Reeves Thrombocytes and Blood Coagulation —K Furusawa The Respiratory Quotient of the Excess Metabolism produced by Muscular Work —A St. G Huggett and Prof J Mellanby Preparation and Properties of Secretin —L N Katz The Asynchronism of the Contraction of the two Ventricles —E C. Smith Insulin and Fat Metabolism —R Kinosita Effect of Breathing against a Resistance —J Needham and Dorothy Needham The pH and rH of the Cell-Interior—a Micro-Injection Study —D Burns (1) The Inter-relation of the Parathyroids and the Gonads, (2) Guanidine in Urine —Sybil Cooper The Rate of Conduction in Nerve in the Supernormal Phase of Recovery —C D Murray and H Taylor Method of Determination of the Oxygen and CO_2 in Mixed Venous Blood

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at Manchester College of Technology), at 7 —J G Robinson Moulding a large Fly-Wheel (Lecture)

MONDAY, JANUARY 19

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4 30

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Dr. Dorothy M Wrinch Seismic Phenomena

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—C. S. Wright: The Origin and Movements of the Ross Barrier.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Recent Discoveries of Fossil Man (I.): The Antiquity of Man in South Africa: The Boskop Skull: The Relationship of the Boskop Race to Bushmen and Hottentot.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 7.—A. J. D. Humby: Turbo Blowers.

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St. Mary's Parsonage, Manchester), at 7.15.—J. Prior: Confectionery Machinery.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—C. Macbeth: Low-Pressure Pneumatic Tyres.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.30.—Sir Oliver Lodge (Lecture).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Dr. O. Faber: Applications in Building and Foundations of Modern Engineering Construction.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—W. O. Brigstocke: Pickwickian Senses.

ROYAL SOCIETY OF ARTS, at 8.—V. E. Pullen: Radiological Research—a History (1). (Cantor Lectures.)

TUESDAY, JANUARY 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. Fowler: The Analysis of Spectra (II.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

MINERALOGICAL SOCIETY (at Geological Society), at 5.30.—Miss K. Yardley: An X-ray Examination of Calcium Formate.—J. Parry and Dr. F. E. Wright: Afwillite, a New Hydrous Calcium Silicate from Dutoitspan Mine, Kimberley, South Africa.—Prof. P. N. Chirvinsky: On Tyuyamunite from Tyuyu Muyun Radium Mine, Fergana.—Dr. L. J. Spencer: International Agreement in Mineralogical and Crystallographical Nomenclature.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Eng. Lt. A. Marsden: Oil Fuel Burning in Steam Generator and Furnace.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Derby Technical College), at 6.45.—C. Beaver: Some Points in the Manufacture and Installation of High-Voltage Cables.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—H. W. Taylor: Three-Wire Direct-Current Distribution Networks.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Kinematograph Demonstration of some Experiments in Physics.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineers' Club, Wolverhampton), at 7.30.—C. Macbeth: Low-Pressure Pneumatic Tyres.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (Informal Meeting) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Miss Kennedy: Electric Cooking.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.), at 8.30.—F. Ll. Jones: The Laws of Nations and the Health of Nations.

WEDNESDAY, JANUARY 21.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Recent Discoveries of Fossil Man (II.): The Rhodesian Skull: The Relationship of Rhodesian Man to Living and Extinct Types of Mankind.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. Léon W. Collet: Recent Views on Alpine Tectonics.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 6.—Sir Oliver Lodge: Matter and Radiation (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Chamber of Commerce, Birmingham), at 7.30.—J. G. Sheriffs: Steering.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—W. E. Burnand: Inventions and Patents.

INSTITUTION OF PRODUCTION ENGINEERS (at Engineers' Club, Coventry Street, W.), at 7.30.—H. A. Randall: Instruments and Gauges.

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—C. J. P. Cave: The Present Position of Meteorology and Meteorological Knowledge.

ROYAL MICROSCOPICAL SOCIETY (Annual Meeting), at 7.45.—A. Chaston Chapman: The Yeasts: a Chapter in Microscopical Science (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—Mrs. Graydon-Stannus: Irish Glass, Old and New.

SOCIETY OF GLASS TECHNOLOGY (at Birmingham).

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—Prof. H. C. H. Carpenter and Miss C. F. Elam: Experiments on the Distortion of Single-Crystal Test Pieces of Aluminium.—J. V. Howard and S. L. Smith: Recent Developments in Tensile Testing.—R. L. Smith-Rose and R. H. Barfield: On the Determination of the Directions of the Forces in Wireless Waves at the Earth's Surface.—*Papers to be read in title only*:—Prof. D'Arcy Thompson: On the Thirteen Semi-regular Solids of Archimedes, and on their Development by the Transformation of Certain Plane Configurations.—W. S. Farren and Prof. G. I. Taylor: The Heat developed during Plastic Extension of Metals.—U. R. Evans: The Colours due to Thin Films on Metals.—A. Campbell: On the Determination of Resistance in Terms of Mutual Inductance.—S. Butterworth: On the Alternating Current Resistance of Solenoidal Coils.

LINNEAN SOCIETY OF LONDON, at 5.—The President and R. D'O. Good: The Recent Meeting in Canada of the British Association.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. S. Huxley: The Courtship of Animals and its Biological Bearings (II.).

ROYAL AERONAUTICAL SOCIETY, at 5.30.—Major R. V. Southwell: Some Recent Work of the Aerodynamics Department, National Physical Laboratory.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. W. Clothier: The Design of Electrical Plant, Control Gear and Connexions for Protection against Shock, Fire and Faults.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates Meeting) (at Luton), at 7.30.—A. C. Saward: Carburation.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (and Society of Chemical Industry, Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—Prof. J. Hendrick: The Alsatian Potash Mines.

FRIDAY, JANUARY 23.

ROYAL DUBLIN SOCIETY, at 4.30.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Dr. B. W. Clack: An Investigation of the Measurement of Small Differences of Refractive Index by the Rayleigh Interferometer.—J. Taylor and W. Clarkson: A Study of the Production of Flashing in Air Electric Discharge Tubes.—C. R. Darling: A Kinematographic Study of Plateau's Spherule (Demonstration).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Recent Discoveries of Fossil Man (III.): Recent Discoveries in Australia and Java and their Bearing on the Theory of Man's Evolution.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Reports to the Cutting Tools Research Committee.—Dr. W. Rosenhain and A. C. Sturney: Flow and Rupture of Metals during Cutting.—Dr. T. E. Stanton and J. H. Hyde: An Experimental Study of the Forces exerted on the Surface of a Cutting Tool.

THE SOCIETY OF DYERS AND COLOURISTS (London Section) (at Australia House, Strand), at 7.—J. Craft: Incorporation of Eulan into Woollen Textiles and other Fabrics, Permanent Protection against Moth Damage (Lecturette).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Lantern Lecture.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Parsons: Boiler-house Records and their Practical Value (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.—E. A. Eborall: Railway Electrification in Switzerland (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—T. Lewis: Gas Producers.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street, W.C.), at 8.—Prof. A. M. Carr-Saunders: The History of the Limitation of Numbers.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. W. Crossley: Science and the Cotton Industry.

PUBLIC LECTURES.

MONDAY, JANUARY 19.

KING'S COLLEGE, at 5.—Dr. J. A. Hewitt: Carbohydrate Metabolism (Succeeding Lectures on January 26, February 2, 9, 16, 23, March 2, 9.)

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Dr. E. B. Behrens: International Problems of Industry (I.): Historical Background, and the Competitive Element in the Determination of Conditions of Labour.

UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Lectures on the Anatomy and Physiology of the Sympathetic Innervation of the Striated Muscle, prepared for delivery by the late Prof. J. I. Hunter (Succeeding Lectures on January 26 and February 2.)

KING'S COLLEGE, at 5.30.—Prof. E. V. Appleton: The Rôle of the Atmosphere in Wireless Telegraphy.

TUESDAY, JANUARY 20.

UNIVERSITY OF LEEDS AND LEEDS PHILOSOPHICAL AND LITERARY SOCIETY (at Leeds University), at 8.—Prof. A. Gilligan: The Geology of Yorkshire: Cleveland and the Yorkshire Wolds.

WEDNESDAY, JANUARY 21.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—W. H. Ansell: The Principles of Design as applied to Buildings.

KING'S COLLEGE, at 5.30.—M. L. W. Laistner: The Decay of Geographical Knowledge and the Decline of Exploration, A.D. 300–500.

UNIVERSITY COLLEGE, at 5.30.—H. Jenkinson: The Public Record Office and Archives.

THURSDAY, JANUARY 22.

UNIVERSITY COLLEGE, at 5.—Dr. A. S. Parkes: The Physiology of Reproduction. (Succeeding Lectures on January 29, February 5, 12, 19, 26.)

FRIDAY, JANUARY 23.

UNIVERSITY COLLEGE, at 11 A.M.—Prof. A. V. Hill: The Physiology of Muscle and Nerve. (Succeeding Lectures on January 30, February 6, 13, 20, 27, March 6, 13, 20, 27, April 3, 10.)

UNIVERSITY OF LEEDS AND LEEDS PHILOSOPHICAL AND LITERARY SOCIETY (at Philosophical Hall, Leeds), at 8.—Prof. D. M. S. Watson: The Origin of Land Vertebrates.

SATURDAY, JANUARY 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—W. J. Perry: Rough Stone Monuments and their Builders.

SATURDAY, JANUARY 24, 1925.

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Fuel Research.

ONE of the most important of the subjects dealt with in the recent annual Report of the Committee of the Privy Council for Scientific and Industrial Research is that of fuel. Fuel is in Great Britain practically the sole source of the power which is essential to all our large industries. The only fuel of national importance produced at the present time is coal, and on the economic use of our diminishing supplies of it the prosperity of the country largely depends. This is now becoming a platitude, but the complexity of the problem involved is by no means realised by many popular writers on the subject.

The coal as it exists in the ground is a highly complex substance, and its constitution varies very widely, even through the thickness of a single seam. The quantity and nature of the volatile content, of the "ash" content, the coking power, the moisture content, and the calorific value all vary, as well as the amount of impurities such as sulphur, arsenic, or phosphorus which, while never intrinsically large, may for some purposes be very important. Analyses and determinations of calorific value, while giving much useful information, by no means give all the information required to determine the suitability of a coal for any given purpose. For example, it is obvious that a large ash content is undesirable, as the cost of carriage of the ash is the same as that of the coal, and in addition the ash has to be removed from the furnace and disposed of. This is, however, not the whole story. The melting-point of the ash is of importance, and while, for example, a low melting-point is not objectionable for domestic purposes, as it tends to prevent the formation of a powdery ash in the grate, a high melting-point is wanted for industrial purposes to prevent the too ready formation of clinker. Similarly, the composition of the ash may have a considerable influence on the refractory linings of the furnace. Recent investigations indicate that the ash may have subtle effects on the decomposition of the coal under heat, and further investigation may show that these effects are of great importance to the carbonisation industries.

Of recent years increased attention has been given to the removal of ash by washing or other purification processes, but much work remains to be done before it will be possible to recommend the best methods to adopt and the degree of purification that is economically desirable.

Much fine coal is left underground, or if brought up is at present unsaleable, and this constitutes a great waste of potential resources. The difficulty in using this coal is due partly to the high ash content and partly to the difficulties of transport and storage.

There is here a large field for useful research which embraces coal-washing, the causes of spontaneous combustion, and methods of briquetting, but there can be no single solution that will suit all fine coals The solution must depend on the circumstances of each case, and a knowledge of these circumstances can be gained only from a survey of the physical and chemical characteristics of the various coal seams

Another field of research which has as yet been but little explored is that dealing with metallurgical coke The prosperity of the great iron and steel industries depends very largely on the possibility of reducing the cost of the fuel per ton of metal dealt with It is well known that cokes vary widely in their properties and in the economy with which they can be used, but so far, it has proved impossible to say in detail why one coke is better than another It is, then, of importance to find out (*a*) the properties of the coke that are of fundamental importance for metallurgical purposes, (*b*) the characteristics of the raw coal necessary to obtain these properties in the coke, and (*c*) the best method of obtaining the coke from the coal For this purpose again a knowledge of the characteristics of the various coal seams is necessary before the problem can be fully solved

For metallurgical purposes raw coal is often unsuitable, but there are many other purposes where, while raw coal could be used, it is both convenient and economical to treat the coal so as to obtain other forms of fuel The real object of all such treatments is to increase the availability of the heat units, *i e* to provide a fuel which can be more efficiently and conveniently transported and utilised than can the coal itself The most widely used of such treatments is the carbonisation of coal to produce coal-gas and coke, the manufacture of which incidentally produces as by-products a large proportion of the raw material required by our chemical industries The importance of this and of the smokeless nature of the gas and coke needs no emphasis here, but the gasification of all our coal would not be advantageous, even if all coals were suitable for the process. There is necessarily a thermal loss in any carbonisation process, and this loss can only be justified if it is compensated for by the more economical use of the heat units remaining, and in economy of use must be included economy of transport. The over-all thermal efficiency of a carbonisation plant plus a boiler plant, where the combustible products of the carbonisation are all immediately burned under boilers, is necessarily lower than that of a boiler plant utilising the raw coal

The carbonisation of coal at "low temperatures" has been much to the fore of recent years, with the object of obtaining home supplies of oil and a smokeless solid fuel for domestic and industrial purposes, and considerable progress has been made towards the solution of its particular problems Here again it is not all coals that are suitable for the purpose, and all suitable coals will not respond to the same treatment

Whatever aspect of the fuel problem is considered, it is found that a solution of its problems, if looked at from a national point of view, depends on a fuller knowledge of the characteristics of the coal available than we at present possess The Fuel Research Board is therefore correct in placing the physical and chemical survey of the national coal resources in the forefront of its programme, and it is gratifying to learn that the Government has decided that this work shall "be pressed forward at the maximum speed compatible with obtaining proper value for the expenditure"

The Fuel Research Board considered "that the actual work in the coalfields would best be carried out by means of local committees, the personnel of which included colliery owners, managers, consumers, and representatives of the Board and of the Geological Survey By this means it was hoped to obtain the sympathetic co-operation of the owners and managers without which the work could not be carried on." In the two areas in which local committees have been formed, the report states that this co-operation has been given freely It is to be hoped that the same spirit will animate the owners and managers in the other coalfields of the country. There need be no fear that more economical methods of utilising our fuel resources will be detrimental to the coal-producing industry, as the cheapening in the cost of our manufactured products which would result would lead to a greater demand for them, and so keep up the demand for the coal, to say nothing of the possibilities of enabling the collieries to find favourable markets for coal at present unsaleable

The practice adopted by the Survey, of taking samples in the form of a pillar of coal through the whole thickness of the seam, enables each portion of the seam to be examined separately, and thus brings out any peculiarities that may exist in the different layers. It has already been abundantly shown that very striking differences may exist, and that in some cases the different layers may be advantageously separated before the coal is marketed, the extra labour involved being more than compensated for by the increased value of the coal The work of the Survey is, however, not confined to the laboratory examination of small samples, and in suitable cases samples of several hundred tons may be tried out to ascertain their behaviour in full-scale plant

Logarithms de Luxe.

Logarithmetica Britannica being a Standard Table of Logarithms to Twenty Decimal Places By Alexander John Thompson Part 9 Numbers 90,000 to 100,000 (Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs's publication of the "Arithmetica Logarithmica," 1624) Pp xviii+100 (Cambridge At the University Press, 1924) n p

ON the appearance of the first section of this important book, it is appropriate to give some account of the evolution of logarithmic tables

Henry Briggs, the computer of the first great table of logarithms, was born about 1556 at Warley Wood, a hamlet near Halifax, Yorkshire He showed signs of mathematical ability at an early age, and proceeded to St John's College, Cambridge, in 1579 Briggs was elected a fellow of his College in 1588 and remained there until 1596, when he became the first reader in geometry at Gresham College in London

In 1614 Napier's first work on logarithms was published, the "Mirifici Logarithmorum Canonis Descriptio" This book came into Briggs's hands soon afterwards he began to read it with interest, which was changed into enthusiasm by the time he had finished He soon perceived that the system of logarithms which would now be described as having 10 for base would be more convenient in use than that on which Napier's system had been calculated After describing this improvement to his classes, Briggs travelled to Edinburgh in 1615 and discussed it with Napier He remained there a month as Napier's guest, and on his return to London busied himself in calculating logarithms according to the new plan. In 1616 he again visited Napier, taking with him the calculations he had made The results of these calculations were printed in 1617, for the benefit of his personal friends, as "Logarithmorum Chilias Prima" In this rare brochure were given the logarithms of the first 1000 numbers to 14 decimal places Specimen pages are reproduced as a frontispiece to the work now under notice

In 1619 Briggs became the first Savilian professor of geometry at Oxford, settling at Merton College, and resided there for the remainder of his life He continued to carry on his computing, and in 1624, after about eight years' labour, produced the "Arithmetica Logarithmica" This work contains the logarithms to 14 decimal places, together with their first differences, of all numbers from 1 to 20,000 and from 90,000 to 100,000. It is accompanied by a masterly introduction, in which the construction of tables, interpolation by means of differences, and other matters of the greatest importance were dealt with for the first time. Although this work is now very rare and costly, it is said that the edition of the tabular portion was too large and that surplus copies were hawked in the streets of London at eighteen pence each After completing this great book, Briggs, with the help of a few friends, began to fill up the large gap of 70,000 logarithms which had been left These were almost completed when, in 1628, Adrian Vlacq, a Dutchman, published the logarithms of the first 100,000 numbers to 10 decimal places, in a book which he also called "Arithmetica Logarithmica" Although Vlacq had only copied 30,000 logarithms from Briggs's book (cutting them down from 14 to 10 decimal places) and had calculated 70,000 himself, he described his work merely as a second edition Briggs may have felt some disappointment at the way in which he had been forestalled by Vlacq he seems, however, to have been relieved that the burden of printing 70,000 logarithms had been removed from his shoulders In such circumstances most men would have given up computing; but not so Briggs When about seventy years of age, he commenced another great work, the logarithms of the trigonometrical functions, and had almost completed it at the time of his death in 1631 Vlacq printed these logarithms at his own expense and published them in 1633 under the title of "Trigonometria Britannica"

No complete reprint of Briggs's great table of the logarithms of numbers has ever been made, and, up to last year, only two 10-figure tables have been published since Vlacq produced his table in 1628 The need for an extended table has long been felt, and the present work is intended to meet this need Logarithms to a few figures are seldom used in present-day computation, and the modern calculating machines often fail to give results of sufficient accuracy without great expenditure of labour In statistical and computing laboratories—especially where new tables have to be prepared for publication—the original Briggs or original Vega are in greater demand than more contracted logarithmic tables Yet their high cost, their rarity, and uncorrected errors have long rendered new tables desirable

No tribute more fitting than the publication of this new 20-figure table could be paid to the memory of a great man on the tercentenary of his greatest work After extensive inquiries, the compilers have been unable to trace any portrait of Briggs for reproduction in the book

The section now issued gives the first 20 figures in the mantissa of log N for each integer N from 90,000 to 100,000, together with second and fourth central differences for use in interpolation First differences are not tabulated their inclusion would have greatly

increased the bulk of the volume and rendered the cost of producing it prohibitive It is intended to issue eight similar sections at intervals of a few months to include the range from 10,000 to 90,000

Linear interpolation is sufficient to evaluate the logarithm of any number, given as a decimal, correct to 10 figures—and the calculation involved is slight Methods for evaluating a logarithm to 15 or 20 decimals are described on the assumption that the computer has access to a calculating machine. Such machines are now used widely, and the amount of work involved is less serious than would appear at first sight Naturally, a computer who undertakes calculations to 20 significant figures must be prepared for a certain amount of arithmetical labour To evaluate log γ where $\gamma = 0\ 57721\ 56649\ 01532\ 86061$, first put $\gamma/a = \gamma/0{\cdot}6 = 0\ 96202\ 61081\ 69221\ 43435$, which is within the range of the tables Next, $\gamma/a = 0\ 96202\ 61 \times 1{\cdot}00000\ 00084\ 91683\ 78524 = bc$ Log b is found from log 96202 and log 96203 by Prof J. D Everett's central-difference interpolation formula The numerical coefficients involved are taken from an earlier publication of the Biometric Laboratory, prepared by the same author (A J. Thompson's "Table of the Coefficients of Everett's Central-Difference Interpolation Formula," Tracts for Computers, V, Cambridge University Press, 1921) A short supplementary table gives the logarithms of numbers between 10^{10} and $10^{10}+100$, and log c is obtained by interpolation between log $(10^{10}+84)$ and log $(10^{10}+85)$. Finally, log $\gamma = \log a + \log b + \log c = \bar{1}\ 76133\ 81087\ 83167\ 61054$, and this is correct to the twentieth decimal place

Of the scheme which has been begun we have but one criticism to offer. We think the table should be extended so as to include 21-figure logarithms of integers between 100,000 and 110,000 The $(k+1)$th figure of N when $1\ 0 < N < 1\ 1$ has only the same significance as the kth figure in the main body of the table If α, β are small and positive,

$$\delta = \log(1+\alpha) - \log(1+\beta) = \mu(\alpha-\beta),$$
$$\delta' = \log(1-\alpha) - \log(1-\beta) = -\mu(\alpha-\beta)$$

approximately Since, however,

$$1+\alpha = 1{\cdot}0 \qquad , 1+\beta = 1\ 0 \qquad ,$$
$$1-\alpha = 0\ 9 \qquad , 1-\beta = 0\ 9 \ . \qquad ,$$

the tabulated value of δ, when k-figure logarithms are used throughout, will be ten times as great as the tabulated value of δ' The value of the $(k+1)$th figure in the logarithm of a number just exceeding unity is apparent in many applications of the tables, *e.g.* in actuarial work and in stability problems in dynamics. This need has been recognised by the compiler of Chambers's 7-figure tables, which include 8-figure logarithms of numbers between 100,000 and 108,000.

Both Mr. Thompson and the Director of the Biometric Laboratory in University College (Prof Karl Pearson), London, are to be heartily congratulated on the publication of this book, the former for his enthusiastic energy which has not been damped by the seriousness of the labour involved in calculating the table, and the latter for undertaking the production of it Such an enterprise is not one of profit a wide readiness on the part of the mathematical world to commemorate with the promoters the tercentenary of the "Arithmetica Logarithmica" can alone ensure the success of the venture

Earthquakes and Geology.

La Géologie séismologique les tremblements de terre Par le Comte de Montessus de Ballore Pp xiv+488 +16 planches (Paris Armand Colin, 1924.) 50 francs.

TO those who value the work of M de Montessus de Ballore, this posthumous volume will be a welcome surprise. It forms the third of a well-known series The first, "Géographie séismologique," based on the distribution of 171 thousand earthquakes, was published in 1906. The second, "La Science séismologique"—the most detailed treatise that we possess on earthquakes in general—appeared in 1907 Then followed a long gap during which the author was mainly occupied in organising the Chilian Seismic Service. In the evening of his active life he has written the volume before us, the text of which he lived to send to the press, though the task of proof-correcting and the selection of the illustrations were done by others M Pierre Termier has contributed the preface, and M. Armand Renier a short biography of Montessus and a useful list of his books and memoirs

"La Géologie séismologique" is less a treatise on the origin of earthquakes than a series of descriptions of important earthquakes with special reference to the phenomena of geological interest Montessus divides earthquakes into two main classes, glyptogenic or geological and external dynamic earthquakes. The former are further rearranged into epeirogenic, tectonic, and epeirogenic and tectonic, according as the surface displacements are vertical, horizontal, or vertical and horizontal combined Under the term external dynamic earthquakes are included volcanic earthquakes and rock-fall earthquakes (tremblements de terre d'écroulement). Between the two classes lie the majority of earthquakes, those which produce no apparent individual effect on geological structure, and which he therefore leaves unconsidered He regards the connexion of these shocks with glyptogenic earthquakes as a very plausible induction and nothing more. Yet if, as in the Inverness earthquakes of 1901, the

epicentres can be traced shifting to and fro along a line of fault, if in their migrations they follow the same law as the after-shocks of the Japanese earthquake of 1891, the conclusion that they are glyptogenic is surely more than plausible In any case, do not such earthquakes deserve consideration as much as purely volcanic earthquakes (to which 62 interesting pages are given), and more than rock-fall earthquakes, which are unimportant from a geological point of view ?

The terms adopted by Montessus are, in one or two respects, unfortunate The word *tectonic* has hitherto been applied to all earthquakes due to the growth or moulding of the earth's crust There seems no valid reason for confining it to earthquakes connected with horizontal displacements The name of the third class, epeirogenic and tectonic, is cumbrous Terminology, however, is of less consequence than the classification implied, which is a useful one.

Under the heading of epeirogenic earthquakes are included the great earthquakes of New Madrid in 1811, Assam in 1897, and Kangra in 1905. The Chilian earthquakes of 1822, 1835, and 1837 would have been added if it were certain that they were accompanied by elevation of the land But the author accepts Suess's arguments—which seem to me inconclusive—and considers that those who saw definite traces of elevation were mistaken Possibly he would have revised this opinion could he have known of the recent observations in Japan (see NATURE, January 10, p 65) on the later settling of elevated tracts.

Typical examples of tectonic earthquakes are the Owen's Valley earthquake of 1872, the Sumatra earthquake of 1892, and the Californian earthquake of 1906 , those of epeirogenic and tectonic earthquakes are the New Zealand earthquakes of 1848 and 1855, the Japanese earthquake of 1891, and the Alaskan earthquakes of 1899. Of volcanic earthquakes, accounts are given, among others, of the Hawaiian earthquake of 1868, the Ischian earthquakes of 1883, etc., and earthquakes connected with various eruptions in Japan and the Philippine Islands

The chapters in which these earthquakes are described form, roughly, two-thirds of the book. Of the remaining third, half is given to secondary glyptogenic effects of earthquakes, such as the isostatic readjustment of alluvial plains, the subsidence of coasts and submarine talus (including accounts of the Jamaica earthquakes of 1692 and 1907 and the Messina earthquake of 1908), and avalanches, effects on glaciers, etc. The latter half contains interesting discussions of some miscellaneous questions, such as changes in topography produced by earthquakes, the influence of geological conditions on the trend of isoseismal lines, the migration of epicentres, and the geographical distribution of earthquakes The last two chapters might well have been longer ; perhaps they were hurriedly finished in the closing days of the author's life. Of the migration of epicentres, two examples only are given, of the Calabrian earthquakes on a small scale, and of earthquakes along the unstable circum-Pacific circle on a large scale A page or two on the migration of after-shock epicentres, which is merely touched on, would have been a welcome addition As the author remarks, such a study would tend to nothing less than the prevision of earthquakes. Still more effective for the purpose would have been a study of the migration of fore-shock epicentres. For example, in those of the Japanese earthquake of 1891, the distribution of epicentres during the years 1890 and 1891 outlined the future zones of dislocation and clearly pointed to the coming earthquake.

There are few omissions of any consequence Some have been suggested above, the principal one being the absence of reference to shocks of small intensity. In the account of the Ischian earthquakes, Johnston-Lavis's monograph is not mentioned The important part played by after-shocks is not considered in detail. Such omissions, however, are of small account in comparison with the great service that the author has rendered Here, under one cover, are gathered materials collected from widely scattered sources. Few, if any, writers have had Montessus's acquaintance with the literature of earthquakes, and there are not many libraries, either public or private, that contain all the works from which he has drawn his admirable illustrations. In no way is this last volume inferior to its two predecessors. To have produced it is a worthy ending to a life of unceasing labour in the cause of science C DAVISON.

Egyptian Mummies.

Egyptian Mummies By Prof G Elliot Smith and Warren R Dawson Pp 190+65 plates (London. G Allen and Unwin, Ltd , 1924) 25*s* net

PROF ELLIOT SMITH and Mr. Warren Dawson have written a very interesting and useful book on mummies, which appears in a most attractive guise (except for some of the illustrations) Its outward show would seem to indicate that it is intended for the general reader who is "keen on" mummies and mystery rather than for the scientific student, but the latter will find in it much detail of purely scientific (and more especially pathological) interest, besides a sketch of the history of the practice in Egypt which, being written by the chief authority on the subject, can be accepted without question The book takes the place of the old and out-of-date work of Pettigrew,

which hitherto has been almost the only treatise specially devoted to the subject, though the archæological reader will find a very useful chapter on the matter in Sir Ernest Budge's long out-of-print book, "The Mummy"

On the archæological side the book is unexceptionable, until the writers (as we fear was to be expected) launch into a dogmatic statement (rather than, as one would have preferred, a reasoned justification) of the now well-known "diffusionist" theory of the spread of all human culture from Egypt, even so far as America via Polynesia, of which Prof Elliot Smith is the protagonist They inform us, as if the matter were settled fact, that mummification spread via India to Malaysia, Torres Straits, Polynesia, and finally Peru and Mexico, "and became widely diffused in both continents of America" (pp. 164, 165) There is no peradventure in this matter for these authors it is as settled a fact for them as is any religious dogma for its *croyants*, and is calmly assumed to be a known fact Let it first be proved to be even a probable theory It is not yet accepted as such by the archæologists It may eventually be proved to be a probable theory, we do not say that it will not or cannot, because we have no *beliefs* on these subjects whatever we consider *beliefs* about anything relating to the early history of man and the origins and diffusion of his culture to be totally unjustified and unscientific., one is still dimly groping in the dark of theories and hypotheses, not dealing with mathematical certainties. The "diffusionist" theory is just one of these hypotheses which *may* be true but cannot yet be proved to be so, any more than any other theory of the kind, and until it is proved so, should not be stated as uncontroverted fact, which it is not

On the archæological side, the authors clearly state the extremely probable origin of mummification in the drying-up of the body in the hot rainless desert sand of the primitive Egyptians' graves, which first gave the idea of preserving the dead in the pathetic hope that they could in some muddle-headed way be made to live again It was a protest against death, which the Egyptians loathed · "O ye who love life and hate death," begins the prayer which summons the living to come and bear their offerings of food to the tomb that the dimly imagined "double" or *ka* of the deceased might feed upon it and somehow "live" Then we are told how true mummification began with the addition of preservatives and bandages, first only in the case of the king and then of his nobles The common people were not embalmed even in the most summary way until much later Then we see how the practice grew and developed, until it reached its apogee in some respects in the time of the XVIIIth–XIXth Dynasties, though it was not until the XXIst that the mummy became a sort of human statue much like those proposed by Jeremy Bentham Finally we see how it declined until Christianity abolished it, after a short struggle with those Egyptian Christians who wished to retain their ancient national practice

Chapters on the funerary furniture and amulets of the mummy, the spells of the Book of the Dead, etc, are given, and a useful list of those kings whose tombs and mummies are known

The pathological side of the inquiry is, of course, well represented, and physicians will find interesting the proofs of the existence of dental and tubercular caries, leprosy, Pott's disease, gall-stones, osteosarcoma, mastoid disease, talipes, and *Dystocia adiposogenitalis* among the ancient Egyptians, to whom, however, syphilis seems to have been unknown Prof Elliot Smith gives several photographs of such pathological conditions.

The photographic illustrations are good, but the non-photographic ones are very unsatisfactory woodcuts after well-known photographs which surely might themselves have been used Fig 16 is a case in which one of the least unpleasing mummies has been made hideous in the woodcut, which is drawn from an admirable photograph We are sorry to see these ugly blemishes in a most useful book H R Hall

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Our Bookshelf.

Allen's Commercial Organic Analysis Edited by Samuel S Sadtler, Dr Elbert C Lathrop, and C Ainsworth Mitchell Vol 2 *Fixed Oils, Fats and Waxes, Special Characters and Methods, Butter Fat, Lard, Linseed Oil, Higher Fatty Acids, Soap, Glycerin, Wool-fat, Cloth Oils, Sterol Alcohols* Fifth edition, revised and in part rewritten Pp ix+807 (London J and A Churchill, 1924) 30s net

A period of fourteen years has elapsed since the publication of the equivalent volume in the last edition of Allen's "Commercial Organic Analysis" The reputation of this standard text-book is definitely upheld in the new volume A comparison of the old and new shows that a thorough revision of data from the analytical investigation of fixed oils, fats, and waxes has been made, resulting in a considerable increase in the size of the book A part of the increase is due to the fact that, while giving the latest and best methods, the older methods have in many cases been also intentionally retained The section on the special characters and modes of examination of fats, oils, and waxes has been doubled in size and now covers nearly half the book, while some of the smaller sections show a fourfold expansion Many subjects practically unknown in commercial analysis when the previous issue appeared (*e g* fermentation glycerin, vitamins, montan wax, etc) have now their place in the new edition

In the refined glycerin section, a reference is given

to the excellent "Ardeer Analytical Methods" book, but, so far as the reviewer is aware, this analytical process book is only available for private use in the Nobel Laboratories

The book, which is printed in the United States, is excellently produced and the price reasonable compared with present-day standards The increase in cost compared with the price of the former edition is less than proportional to the increase in size

J REILLY.

Evenings with the Stars By Mary Procter Pp ix+212+8 plates (London Cassell and Co, Ltd, 1924) 10*s* 6*d* net

THIS work is not to be confused with the "Children's Book of the Heavens" by the same author It is an entirely new work and is intended for amateur astronomers, and for those who wish to learn something about the constellations, both in their appearance in the sky, and in the wealth of legendary lore connected with them Accordingly, the division is into twelve evenings or chapters, each dealing with a certain number of constellations near to one another in the sky, until the whole of the constellations visible in northern latitudes have been passed in review. The work is, in a spirit of filial piety, dedicated to the father of the author, the late distinguished astronomer, R A Procter, "who taught me how to know and love the stars" From him she has inherited another gift, that of lucid and interesting description

Each chapter is illustrated by a series of very clear and well-drawn original charts, by means of which the reader and student is safely piloted through the constellations After a description of the constellation, the chief objects of interest are pointed out, with many aptly-chosen illustrative quotations from literary and legendary allusions to such objects Appended to the twelve chapters is an interesting poem, the "Voices of the Suns," by the father of the author There is also an excellent index, and in addition eight beautiful plates of nebulæ The frontispiece in particular is a fine reproduction of the great cluster in Hercules, as photographed at the Dominion Astrophysical Observatory with the 72-inch reflector

The book, too, is very well printed Both for its astronomical and its literary excellence it can be highly recommended, and is deserving of a wide circulation It is the work, too, of an expert.

A L C

The Soil and its Management By Prof Merritt F Miller Pp vi+386 (Boston and London Ginn and Co, 1924) 7*s* 6*d* net

PROF MILLER'S book is designed for schools teaching vocational agriculture and for short-course students in agricultural colleges, and forms an admirable introductory course in agriculture Little or no acquaintance with chemistry and other sciences is assumed The author has succeeded notably in avoiding technicalities and has produced a most interesting and readable account of soils, soil fertility, and soil management without loss of clearness or accuracy

The general arrangement is not very different from that adopted in most text-books dealing with the soil, but the treatment is unusually full for an elementary work, and the constant reference to farm practice and to observations and experiments which may readily be made on the farm and in the countryside is an attractive characteristic At the end of each chapter there is a series of questions, together with skilfully selected practical exercises, both in the laboratory and in the field, and "home projects" for the benefit of the boy who lives on a farm There are also references to more advanced books dealing with the various aspects of the subject The numerous illustrations from photographs are another special feature they are well reproduced and are very much to the point—particular mention may be made of the little series of pictures showing the crops in different rotations

The author writes for American students and with American farming practice in view, and there is a good deal that is not directly applicable to conditions in Great Britain, but it is a work which all who have to do with the elementary teaching of agriculture will find most useful

C T. G

Butterflies of India By Chas B Antram Pp xvi+226 (Calcutta and Simla · Thacker, Spink and Co, 1924) 30 rupees.

THIS book is intended for the uninitiated, and its primary object is to illustrate all the Indian butterflies, except a few which are very closely alike More than 500 species are dealt with, leaving the Lycænidæ and Hesperiidæ for treatment in a second volume A few notes on the collection and preservation of specimens are given, and the remainder of the book is occupied with short and, so far as possible, non-technical specific descriptions The characters given for three out of the four families are popularised, we think, to the extent of inefficiency, while the Nymphalidæ are not diagnosed at all. Generic keys or tables are dispensed with, no doubt on account of the difficulty of translating them into non-technical language The reader, therefore, needs to compare his specimens with the illustrations and descriptions until he alights upon the correct species After a little practice he will probably experience no great difficulties in doing so

The book is well produced and will, no doubt, prove to be a useful popular guide for the many collectors of these insects scattered through India On p 38 there is a description of a new species of Parnassius from Tibet it is hoped that the author will also publish a technical diagnosis of the insect, if he has not already done so, in some scientific periodical.

Lehrbuch der anorganischen Chemie Von Karl A Hofmann Funfte Auflage Pp xiv + 761 + 7 Tafeln (Braunschweig F Vieweg und Sohn A-G, 1924) 17·50 gold marks

PROF HOFMANN'S text-book has been carefully revised and brought up-to-date It gives a clear and fairly detailed account of the subject along recognised lines, including the rarer elements, and will be found useful by advanced students As in most German text-books, a section on explosives is added It gives an impression that German students make a special study of this subject.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications*]

Dutch Pendulum Observations in Submarines.

IN the letter from Mr Bowie on the subject of Dr. F A. Vening Meinesz's pendulum observations on board a submarine, which appeared in NATURE of December 27, 1924, p 930, there is a passage which seems to me to suggest a wrong idea of Dr. Meinesz's method and thereby perhaps to engender doubts as to the possible accuracy of his results

Mr Bowie quotes the following pargraph from a paper which he presented at the Pan-Pacific Scientific Congress of 1920 "It is hoped that a satisfactory apparatus may be devised for determining the intensity of gravity at sea, using special vessels or commercial vessels There are several types of apparatus in existence, but no one of them gives results of sufficient accuracy for the study of isostasy The writer suggests that it may be possible to obtain a fair value of the intensity of gravity at sea by the use of the land apparatus properly mounted on a vessel The apparatus would have to be swung in double gimbals and should be placed near the point of minimum translation resulting from the pitching and rolling of the vessel," and adds, "It was with great satisfaction that I read that Dr Meinesz had accomplished the accurate determination of gravity at sea with the use of pendulums No doubt he arrived at the conclusion that the pendulum could be used independently of my suggestion in 1920."

The passage gives the impression that Dr Meinesz's method consists of so mounting the apparatus as to reduce the disturbance due to the pitching and rolling of the vessel to a negligible quantity But this is not the method at all, and indeed one may reasonably doubt whether it would ever be possible to produce on board a ship a stillness at all comparable to that enjoyed by what the inhabitants doubtless consider the *terra firma* of the western part of Holland, yet in that region the instability of the ground is such that Dr Meinesz found it impossible to obtain any result by means of the pendulum apparatus used in the ordinary way, as the disturbance of the time of oscillation of the pendulum caused by the movements of the ground was far too great The same difficulty has been met by other observers in places where the conditions are similar to those found in western Holland

To overcome this difficulty, Dr Meinesz thought of the ingenious plan of swinging two pendulums simultaneously on the same stand He showed by analysis that from observations of the times of swing of the two disturbed pendulums it was possible to deduce the time of swing of a hypothetical pendulum, the length of which is constant so long as those of the two real pendulums do not vary, and the time of swing of which is independent of the disturbances suffered by the real pendulums The two pendulums are swung in the same plane and on the same support, that is to say, their knife-edges are parallel and the surfaces on which they swing are rigidly connected The idea of the method, to state it quite roughly, is that the two pendulums suffer equal but opposite disturbances, so that a mean undisturbed value is deducible

This method was found to give excellent results on the slightly unstable soil of Holland, and has also been found to give good results on a submarine where the instability, though much less than that of a ship floating on the surface, is nevertheless enormous compared with the least stable of the land stations

I cannot believe that attempts to reduce the effects of a ship's movements by such devices as gimbals and the like would ever have been successful in freeing a pendulum, swinging by itself, from disturbances too great to be tolerable, but Dr Meinesz introduces a new idea quite different from that of damping out the effects of the movements

It is very desirable that the originality of Dr. Meinesz's method should be recognised and that he should have full credit as the sole inventor of a plan which seems to have solved the problem of the determination of gravity at sea

G P LENOX-CONYNGHAM

Trinity College,
Cambridge, December 30

On a Connexion between the Spectra of Argon and Ionised Potassium.

THE quantitative relations between the spectra of argon and ionised potassium have been for some time a subject of investigation in the Amsterdam Laboratory The available observations are chiefly due to Schillinger (*Wiener Sitz Ber* 118, 605, 1909), McLennan (Proc R S, 100, 182, 1921), and Dik and Zeeman (*Proc. Kon Acad Amsterdam*, 1922, 1923). Schillinger used a spark for the production of the K^+ spectrum, McLennan, as well as Dik and Zeeman, the electrodeless discharge Dik and Zeeman got a rather pure K^+ spectrum, because with very intense discharges the arc lines were entirely suppressed, a result at variance with that of other observers The observations were obtained with a quartz spectrograph. The accuracy is, therefore, not sufficient for a scrutinising analysis, and observations with a grating spectrograph were projected

Prof Konen kindly informed us that in Bonn such measurements were already in hand, so that they were here postponed From the preliminary observations, Dik and Zeeman concluded that, in the spectrum of ionised potassium, constant differences of about 847 and 1696 were present, and this would point to a connexion with the red spectrum of argon (Rydberg) Afterwards the present authors (De Bruin and Zeeman, NATURE, Sept 6, 1924, p 352) investigated the blue spectrum of argon (accurate measurements of Eder and Valenta), and it appeared that a difference of about 846 here is also characteristic, as well as about 414 also found with the spectrum of K^+ Afterwards we found that Paulson (*Astr Journ*, 41, p 75, 1915) had also hit upon the difference of about 846 in argon Recently, Dahmen (*Zeitschr f Phys*, 29, 1924, p 264), of Bonn, has published measurements on ionised potassium, using a large grating, and potassium electrodes in an atmosphere of argon In his experiments the arc lines are not absent, but his results are far more accurate

From an examination of this new material, we have come to the conclusion that the difference of about 847 is not characteristic and probably cannot be maintained. The difference of about 1696 is present, a more accurate value being about 1712 Instead of the difference of about 414, we now find 418 2 for ionised potassium

We have found some groups of regularly distributed lines exhibiting also regular distribution of intensities, a fact of some importance for the further analysis, because the intensities are closely connected with the inner quantum numbers In the "quintets," the second component has the greater intensity, surpassing

always the first and third component These groups of lines allow us to conclude that in Dahmen's observations some lines are absent which are present in Dik and Zeeman's tables

Some examples of "quintets" may be given here

I

I	ν (Vacuum)		
2	20224 50	(D, Z)	←890 96→ ←1507 00→ ←1980 01→
	1468 83		
5	21693 33	(G)	
	1089 05		
3	22782 38	(G)	
	417 95		
4	23200 33	(G)	
	473 01		
5	23673 34	(G)	

II

I	ν (Vacuum)		
2	21753 81		←891 04→ ←1507 00→ ←1980 22→
	1468 82		
3	23222 63	(G)	
	1089 18		
1	24311 81	(G)	
	417 82		
2	24729 63		
	473 22		
3	25202 85		

III

I	ν (Vacuum)		
4	22189 68	(G)	←891 39→ ←1507 04→ ←1980 18→
	1468 93		
5	23658 61	(G)	
	1088 79		
1	24747 40		
	418 25		
3	25165 65		
	473 14		
2	25638 79		

IV

I	ν (Vacuum)		
6	24178 63	(G)	←891 80→ ←1507 11→ ←1980 65→
	1469 17		
8	25647 80		
	1088 85		
2	26736 65		
	418 26		
6	27154 91		
	473 54		
5	27628 45		

V

I	ν (Vacuum)		
(7)	23449 36	(G)	←891 73→ ←1507 11→ ←1980 61→
	1468 76		
1	24918 12		
	1088 88		
0	26007	(D, Z)	
	418 23		
1	26425 23		
	473 50		
1	26898 73		

(D, Z) means observed by Dik and Zeeman

(G) refers to Goldstein's observations of the "Grundspectrum" Goldstein (*Verh deutsch phys Ges* 321 1907, 426 1910), who was the first to obtain the spectrum of ionised potassium, observed 16 lines in the red part of the spectrum Ten of these lines are incorporated in the "quintets" given

Further details will be published by one of us (de B) on another occasion

T L DE BRUIN
P. ZEEMAN

Amsterdam, December 29

The Ages of Peat Deposits.

DR W H PEARSALL'S article on this subject in NATURE of December 6 refers to the absence of definite forest layers in the Pennine peat, in contrast to the peat with tree layers described by Lewis and others Dr Pearsall appears to have overlooked the fact, however, that both the age and composition of mountain peat may differ considerably from that of marsh peat, in which tree layers are invariably found, and the presumption is that the Pennine peat to which he refers belongs to the former class The absence of tree layers in mountain peat is general throughout Ireland, whatever it may be elsewhere This is due, not to the elevation at which it is formed, but to the stratum on which it rests, and which is invariably a surface soil, not always waterlogged, but deficient in lime and other alkaline bases, and on which the ordinary decomposition of humus is retarded or checked altogether Tree stumps of Scots pine and birch, and more rarely oak, occur under the mountain peat up to elevations of 1500 feet to 2000 feet, and in situations where trees could not attain a similar size or rate of growth to-day

Dr Pearsall states that tree layers are not necessarily an indication of climatic change, and I agree with him. But they are undoubtedly an indication of change in the soil or peat water upon which the tree layers subsist, and also of the level at which the water table stood when they were growing These root layers invariably show a decreasing size and rate of growth the higher they stand above the water table of the marsh which gave rise to the peat formation The question is somewhat complicated by the fact that in most mountain districts, marsh and mountain peat are intermixed over wide areas, the mountain peat covering the higher and better drained surfaces, and the marsh peat the depressions or hollows which were originally small shallow lakes The former never contains definite root layers, the latter root layers up to the level at which the sphagnum peat was formed, indicating a point at which sterility prevented all plant growth except mosses, stunted heather, and similar plants

So far as I am aware, few investigators distinguish between these two types of peat, and when tree layers are found in the shallow marsh peat of mountain districts, the fact is overlooked that they may be distinctly older than the mountain peat lying between them, and *under*, but *not in* which the tree stumps occur on the natural soil It is highly probable that the mountain peat corresponds in age to the Submerged Forest period, and also to the margins of the deeper and larger bogs of Ireland and Scotland In these margins Scots pine and oak are usually found mixed, but in the deeper layers oak is absent

It is possible that considerable errors may arise by assuming that Scandinavian peat is of the same age as that of Ireland and Scotland Existing peat could not have been formed until the final retreat of the ice sheet, but probably began immediately after that retreat in the form of plant growth in the shallow lakes and marshes Thousands of years may have separated the final retreat of the ice from the British Isles and its retreat from Southern Scandinavia, and in the interval peat has been forming wherever the conditions were suitable, irrespective of climate, although climate must have affected its rate of growth That peat formation is going on to-day can be seen in many parts of the north and west wherever stagnant water accumulates, or soil surfaces are leaching out Neither the marsh peat in the one, nor the mountain peat in the other, is necessarily an indicator of climate, but the root layers in and under the marsh peat suggest that it is of a much greater age than the mountain peat so far as the lower layers are concerned The sphagnum peat is evidently a more recent growth, and reaches a more or less definite height in relation to the average diameter of the bog

A. C FORBES

Forestry Branch,
Dublin

IN NATURE for December 6, 1924, Dr W H. Pearsall directed attention to the results which have recently been achieved in work on the Pennine peat of Yorkshire, and discussed some of the problems of correlation which arise Several of the points raised demand further comment.

After enumerating and discussing the validity of the conclusions reached by Lewis for the Scottish Peat Mosses, Dr Pearsall says "Samuelsson has

reinvestigated the Scottish deposits and his main conclusions agree with those of Lewis" This statement might almost be described as a travesty of the facts Samuelsson (Bull Geol Inst Upsala, Vol X pp 197-260) does indeed confirm the general *succession* established by Lewis, but even in this there is not entire agreement (See, for example, p. 222) Lewis's main conclusions are surely contained in his correlation of the peat succession with the later glacial and interglacial periods of the system devised by James Geikie, and with this correlation Samuelsson disagrees In the early part of a critical discussion (see especially pp 217-226) he says "Lewis has started from Geikie's point of view and endeavoured to bring his results into accordance with Geikie's opinion as much as possible But by holding one-sidedly on to the correctness of Geikie's classification of the late quaternary history of Scotland, Lewis has been led to some conclusions that are certainly wrong"

The arguments of Geikie and Lewis for the interglacial age of part of the Scottish peat may be summarised thus

(1) A submerged forest (with present day flora) underlies the carse lands of the Forth and Tay
(2) These carse lands rise inland and pass into the gravels of the 45-50 ft Raised Beach
(3) Moraines have been seen resting on this beach

Therefore, the Submerged Forest is earlier than the glaciation represented by the moraines The Submerged Forest is taken to be represented in the Scottish peat by the Lower Forestian, the glaciation by the 2nd Arctic Bed (Lower Turbarian), a subsequent emergence by the Upper Forestian, and a further submergence (25 foot Beach) by the Upper Turbarian

This beautifully sequential argument is utterly destroyed by the following considerations

(1) There is no contemporaneity between the carse lands of the Forth and Tay and the gravels of the 45-50 ft beach
(2) There is no independent evidence for the emergence which is supposed to be represented by the Upper Forestian, and, in any case, Samuelsson has pointed out that no such emergence is necessary

Not content with quoting results based on a miscorrelation, Dr Pearsall states "Now along the Scottish coasts, the submerged forests are replaced by the 40-50 ft beaches, also of Neolithic date" This is confusion worse confounded indeed! It is not that the results and conclusions of later workers are hidden away in obscure and widely scattered journals On the contrary, in Wright's "Quaternary Ice Age" (chap xvi) there is a delightfully clear, concise and well-written presentation of the evidence bearing on the raised beaches and submerged forests of the British Isles Here it is plainly stated that there exists in Scotland a group of raised beaches, ranging from the 100 ft to the 40 ft level, which are in part contemporaneous with the existence of large glaciers, and that these are separated from the 25 ft raised beach of Scotland, Northern England and Ireland, by a period of emergence in which the submerged forests grew It is to this ("25 ft") period of submergence that the carse clays of the Forth and Tay belong, and these clays, as well as the associated beach gravels, have been proved, in all cases where the relation can be observed, to overlie the Submerged Forest

The 25 ft beach contains Campignien implements exactly similar in type to those which are found associated with the kitchen middens of the maximum of the Littorina depression in Scandinavia. and, in Scandinavia, this Campignien industry is associated with pigmy flints of Tardenoisien type This evidence appears to contradict Clement Reid's assignation of a Neolithic date to the submerged forest, which is quoted by Dr Pearsall In this connexion, however, it must be remembered that Clement Reid was not speaking of the submerged forests of Scotland and Northern England, and also that the submerged forests increase in number and in depth outwards from Scotland The uppermost submerged forest of Southern England and Wales appears to be of Neolithic or even Bronze Age, but it is possible that the Scottish submerged forest, of which the pre-Tardenoisien age is undoubted, represents the lowest submerged forest of the areas further south

Now Dr Pearsall tentatively correlates the Submerged Forest with the birch forest at the base of the Pennine peat, and suggests that its destruction coincided with the colder climate assumed for the Lower Turbarian Dr Woodhead, however (*Journ Bot*, Oct 1924, p 303), does not assume any increasing cold to account for the destruction of this forest Further, if the Pennine forest lies above sand containing relics of a Tardenoisien industry, and the Submerged Forest lies below gravels of the same date, the two cannot be contemporaneous

It is, of course, very desirable that correlation should be attempted, but, until Dr Pearsall can build on better and on sounder foundations than he has done, it seems a pity that the very beautiful and precise work done by Mr Holmes, Mr Buckley and Dr Woodhead should be obscured by such speculations LAURANCE H TONKS

Manchester, December 12, 1924

MR TONKS raises some interesting points to which further reference seems to me desirable, in regard to my article on the ages of peat deposits That article refers to the peat horizons recognised by Lewis in Scotland and uses the names which Lewis adopted It points out that these "roughly correspond" to Geikie's well-known climatic periods Mr Tonks appears to assume from this that I have accepted and argued from the whole of the implications of the Lewis-Geikie system Nothing could be further from the truth Mr Tonks then apparently accuses me of declaring that Samuelsson has agreed with these implications It is, in fact, evident from the paragraph in which my reference to Samuelsson occurs—that the points of agreement between Samuelsson and Lewis to which I refer are the nature of the Scotch peat succession, its widespread character and its possible relation to climate My opinion that these are the main conclusions to be drawn from the work of Lewis remains unshaken The article further refers to the "submerged forests round the English coasts" and not to those known in Scotland, to which Mr Tonks refers at length There appears to be no clear evidence that the English and Scotch submerged forests are of the same age although the suggestion Mr Tonks makes is quite possible Much of Mr. Tonks's letter is thus based on misinterpretations and misunderstandings

One of the objects of the article was to indicate, so far as possible, that if one attempts to correlate the results of the British and Scandinavian peat investigations, then the results throw considerable doubt on what may be termed the climatic hypothesis of peat stratification This result is actually obtained whether the age of the Scotch peats is estimated through the 40-50 ft beaches, a doubtful method as Mr Tonks shows, or through the 25 ft beaches In the latter

case, according to Lewis, the mosses in Southern Scotland lying on the 25 ft. beaches have a basal layer of shrub remains (largely birch) above which are peat layers chiefly composed of Eriophorum. This stratification agrees with that of the upper layers of the older mosses further inland. The wood layer *may* thus approximate to that of Lewis's Upper Forest layer, and since the 25 ft. beaches are about Campignien age, the Upper Forest would be approximately Neolithic. On the climatic hypothesis, this might be held to suggest that the Neolithic period was relatively warm and dry in Scotland—agreeing on the whole with the Scandinavian conclusion. Yet in the Pennines this period appears to have been one of forest destruction and peat development, which would, on the climatic hypothesis, require cold and moist conditions.

The whole point of these attempted correlations, so far as I am concerned, is that on whatever they are based, they result in throwing doubt on the hypothesis that peat stratification is, in Britain, an indication of climatic change. The method employed in the original article results in the correlation of Lower Turbarian (presumably cold and moist) with the destruction of the Pennine Forest. While this is better so far as Britain is concerned, it means on the climatic hypothesis that in Neolithic Britain conditions tended to be cold and moist, while in Scandinavia they were relatively warm and dry. The point of my article as expressed in the last two paragraphs remains just as clear if the Scottish peats are wholly ignored. They represent, however, the chief British evidence for the climatic theory of peat succession, and hence the attempt was made to include them, though admittedly nothing but the establishment of cultural horizons can give an adequate basis for this correlation.

W. H. PEARSALL.

Acid-base Titrations and Equilibria of Weak Bases and Acids.

IT has been supposed in the past that substances with feebly acidic or basic properties, say with K_a or K_b less than 2.5×10^{-9} in the case of N/20 dilution, are incapable[1] of estimation by acid-base titrations. I have recently succeeded in elaborating a technique by which this object can be attained: the main principles involved are set out below.

The titration of strong acids or bases in the presence of indicators depends on the steep (and maximal) gradient in the degree of acidity (hydrogen ion concentration, P_H) at the "end-point" in the neutralisation. Thus, with a fairly strong base the P_H during a titration is governed by the well-known mass-law approximation,[2]

$$p_{kw} - p_H = \log \frac{1}{[OH']} = \log \frac{1}{K_b} + \log \frac{[\text{Acid added}]}{[\text{Base remaining unneutralised}]}, \quad (1)$$

from which can be deduced the indicator with most suitable transition zone for the titration. An analogous equation holds for the titration of fairly strong acids.

Equation (1) rests on the assumption that all the acid added to the weak base goes to form a completely dissociated salt and that the free base is itself non-ionised. The first assumption is no longer true with a very weak base having a dissociation constant commensurate with that of water: a highly acid solution is formed, a large fraction of the added acid is uncombined with the base, and the effect of the acid on the solute is masked by its effect on the solvent, no end-point being shown when P_H is plotted against added acid. This difficulty has been overcome by a formula and method of approach already applied by the writer to amino-acids and polypeptides.[3] From each value of "Acid added" is subtracted the amount present in the free state, which can be calculated from the equation

$$[H^{\cdot}] = a[\text{free HCl}], \quad . \quad . \quad . \quad (2)$$

where a is known and $[H^{\cdot}]$ is the quantity determined experimentally, and it is found that the formula so modified becomes strictly applicable to the very feeblest bases, and the corresponding modified formula equally applicable to acids. The *modus operandi* of the technique is to determine the volume of standard soda or hydrochloric acid required to titrate the solute over a given P_H range or to a given P_H end-point: for any given K_a or K_b value this is directly proportional to the amount of solute present. With the simplified apparatus now available, such as the Cambridge Instrument Co.'s portable outfit and Mr. S. W. Cole's hydrogen electrode, a complete electrometric P_H determination can be carried out within the space of several minutes.

The theory has now been tested in detail in relation to some thirty acidic and basic groups. The accuracy obtainable is found to be of the same order as that of an ordinary acid-base titration by the old-fashioned method. Thus the very feeble second basic group in arginine ($K = 1.2 \times 10^{-12}$) may be estimated with an accuracy of at least 1 part in 100 in, say, M/20 solutions; while the P_H during the course of a titration may be predicted to within 0.02 P_H units, that is, with an accuracy comparable with that attaching to the experimental reading. With mixtures of acids or bases of different strengths the corrected amounts of alkali (or hydrochloric acid) required to titrate over a given P_H range is the sum of the amounts for each acidic or basic group.

Utilising this fact, I have been able to resolve a compound titration curve into its various components and estimate each of a number of acids and bases or ampholytes present simultaneously in a mixture, even when the respective K_a and K_b values are sufficiently close to cause partial overlapping of the individual titration curves. In order to estimate a given substance, it is not essential to know the exact K_a or K_b values when once its P_H combination curve has been determined; and on this basis I have been able to make accurate determinations of proteins in solution. Details will shortly be published (Proc. Roy. Soc., B.). Other applications have included investigations of the molecular weight and chemical constitution and dissociation constants of several bodies of biochemical interest, and the detection of chemical changes (*e.g.* the disproof of the theory of acid or base addition at peptide linkage in dipeptides) particularly those occurring during denaturation and enzyme hydrolysis.

An experimentally determined "correction for blank" has previously been arbitrarily used by Tague[4] for the action of soda on amino-acids, but without reference to the titration theory, mass law equation, K_a and K_b values, or prediction of titration curves.

In deducing differential expressions for buffer value, Van Slyke[5] (1922) independently made use of a formula which is similar to the present writer's, but in which no account is taken of the incomplete dissociation of the titrant. The effect of the latter on the accuracy of the formulæ is evident from the

[1] J. Chem. Soc., vol. 119, pp. 140, 136 (1921).
[2] *Biochem. Z.*, vol. 78, p. 112 (1917).
[3] Proc. Roy. Soc., B, vol. 95, pp. 440-484, 500-522 (1923-4); J. Chem. Soc., vol. 123, pp. 3294-3303 (1923).
[4] J. Amer. Chem. Soc., vol. 42, p. 173 (1920).
[5] *J. Biol. Chem.*, vol. 52, p. 525 (1922).

following values for the second basic dissociation "constant" of arginine calculated from the experimental P_H values

P_H.	p_{k_b} Harris's Formula	Van Slyke's Formula
3 14	11 90	11 89
2 52	11 90	11 88
1 84	11 90	11 75

It was shown[3] that for amino-acids, results sufficiently accurate for most purposes could be obtained if a in equation (2) were taken as 0 9 when concentrations less than N/10 were dealt with As recently emphasised by Cohn, P_H determined electrically is a measure of hydrogen ion "activity" rather than "concentration" I have obtained results sufficiently accurate for analytical purposes by taking for a Noyes and McInnes'[6] figures for the activity of KCl of the same concentration as that of the total HCl (titrant) added at each stage in the titration Similar conclusions have been reached in titrating weakly acidic groups with soda For highly accurate theoretical purposes I have calculated values of a for use in the presence of weakly basic or acidic groups of amino-acids from Sorensen's very careful P_H determinations of glycine—HCl and —NaOH buffers My theoretical investigations relate mainly the one acidic and one basic group in glycine, and the one acidic and two basic groups in arginine it is intended to publish a detailed report in due course

LESLIE J HARRIS

School of Biochemistry, Cambridge,
and Carrow Research Laboratory, Norwich,
December 16

[6] J Amer Chem Soc, vol 42, p 239 (1920).

The Ages and Masses of the Stars.

IN his article on "The Ages and Masses of the Stars" (NATURE, December 6, 1924), Dr J H Jeans, to account for the source of stellar radiation, considers the possibility of positive and negative charges falling together, annihilating each other, and passing away "in a blaze of glory," thus setting free enormous amounts of "sub-electronic" energy Proceeding, he says, "Nothing in the suggestion appears to conflict with modern atomic physics" and gives his reasons

This may be very true, since we have nothing to disprove such a theory, but to make an assumption of such a fundamental nature, and, as it seems to me, on insufficient grounds, is rather disconcerting to a conservative mind. It requires some imagination to think of an electron and a nucleus, the properties of which are so vastly different, as "cancelling" one another

The author's one strong argument in favour of his theory is based on the loss of the mass of stars as obtained by Eddington (cf NATURE, May 31, 1924) In support of his theory of the annihilation of matter, Jeans makes the highly contestable statement, that "we know of no normal process by which mass can escape except by radiation, whence we conclude that the diminution of mass is the equivalent of the energy radiated away" Objection to this can immediately be raised on the ground that we have direct evidence of a stellar body losing mass, in the case of the tails of comets Moreover, it has been shown by Gouy (*Comptes rendus*, 157, 186, 1913) and Page (*Astrophys. Journal*, vol lii No 2, September 1920) that, in the case of an atomic vibrator, the radiation pressure may very well exceed the gravitational attraction on the surface of our sun It is, therefore, quite imaginable that the sun is losing mass from its surface in this way all the time In a greater degree would this be the case on hotter stars, even though much more massive than the sun

On the other hand, if we reject Jeans's hypothesis, we rob him of his nearly unlimited supply of energy, but could this not, in a small way, be compensated for by attributing to the stars a high degree of radioactivity, this source of energy, I take it, not having been included by the author in his computation of the "super-electronic" energy of the stars?

T SCHUMANN

Sloane Laboratory, Yale University,
New Haven, Conn, U S A,
December 17

THE merit I am inclined to claim for my hypothesis of sub-electronic energy is that this one simple hypothesis clears away a whole tangle of astronomical difficulties The hypothesis may strike the physicist as unproved and unprovable, as it certainly is, but I think the following considerations will show that it ought not to be dismissed as fantastic

A gram of every substance (except hydrogen) contains 3×10^{23} negative electrons and a corresponding quantity of positive electricity Each gram of the sun's mass radiates 60 million ergs per annum, so that if sub-electronic energy is not drawn upon, each of these electric charges must fall through an average potential difference of 0 0012 volts The fall for one year does not look big, but radiation for 10^9 years requires an average fall of 120,000 volts, representing a fall from infinity to only 10^{-12} cm. from a charge $\pm e$ The figure of 10^9 years is the absolute minimum that can be considered, evidence from the orbits of binaries and from the approximate equipartition of energy in stellar velocities calls rather insistently for 10^{13} or even 10^{14} years Also giant stars radiate anything up to a thousand times as much per unit mass as our sun It would be possible to find tolerably good reasons for replacing the above figure of 120,000 volts by 12×10^9 volts, and 10^{-12} cm by 10^{-17} cm If we have to contemplate positive and negative charges getting as near to one another as this, it would seem that they might as well go a bit farther To my mind it is easier to imagine a few charges stumbling into one another than to imagine a whole lot falling through these enormous potential differences and then stopping

Radioactive energy and energy of nuclear rearrangement can, of course, be covered by an argument of the same general type, except that we have to picture charges of the same sign starting at these infinitesimal distances from one another. There is nothing impossible in it, but neither, I claim, is there in the hypothesis of mutual annihilation The inadequacy of the highest degree of radioactivity known to us has been pointed out by Lindemann and others, but it has to be conceded that substances of far higher radioactivity may exist in the stars.

A comet's tail can lose mass, and this loss of mass may be permanent, because the comet's own gravitational field is slight in comparison with the general field of the sun, but the conditions are different for a body of stellar mass So soon as a particle expelled by radiation pressure loses or changes its period of vibration, it will fall back into the star A cosmogony based on the conceptions suggested by Mr Schumann would seem to me to create more difficulties than it removes, but others may think differently Mr. Schumann's cosmogony would certainly fit in well with Prof Lindemann's theory of the nature of spiral nebulæ

J H JEANS

London Fog of January 11-12, 1925.

THE accompanying curve (Fig. 1) indicates the variation in the quantity of suspended impurity in the air of Westminster during the recent fog. There was nothing very abnormal until the night of Saturday, January 10, when the suspended impurity, instead of gradually falling in the afternoon as it usually does, commenced to rise at about 5 P.M., reaching about 2 milligrams per cubic metre by 9 P.M. This level of impurity was maintained until midnight, when the normal fall occurred to a minimum of less than 0·5 milligram per cubic metre at 5-7 o'clock on Sunday morning. After this the impurity rose rapidly until it passed beyond the scale of the recording instrument at 3 o'clock on Sunday afternoon. It remained at this abnormally high level, which was more than 6·5 milligrams per cubic metre—probably approaching 10—until 7 P.M., when a gradual fall commenced, which was maintained fairly steadily until 5 o'clock on Monday morning, when the impurity was a

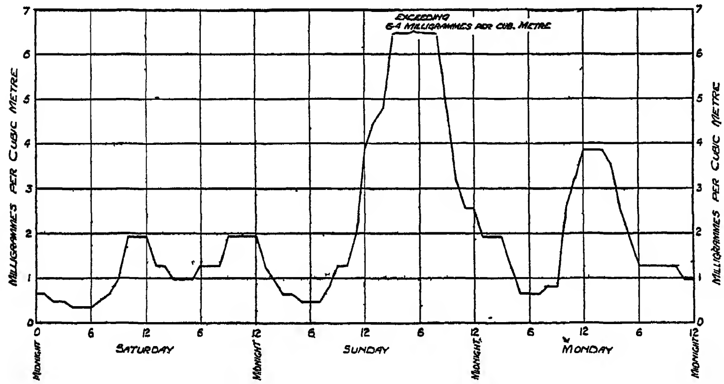


FIG. 1.—Suspended impurity in the air of Westminster, Saturday, January 10—Monday, January 12.

little more than 0·5 milligram. The same rapid increase in impurity again began on Monday morning about 7 A.M., reaching a maximum of a little less than 4 milligrams per cubic metre at noon. This was maintained until 3 P.M., when there was a rapid fall until 6 P.M.

There were one or two interesting points noticeable in this fog. A dust record at 11 o'clock on Monday morning showed a reading of nearly 30,000 particles per c.c. Unfortunately, no dust counts were available for the maximum period on Sunday, but there is usually a relation between the impurity recorded automatically by filtration and the dust count, indicating that about 8000 to 10,000 particles per cubic centimetre correspond to 1 milligram per cubic metre. On this basis there must have been something approaching 100,000 particles per cubic centimetre during the height of the fog on Sunday.

Dust records taken 11 miles south-west of London, at Cheam, on Sunday afternoon, gave 15,000 to 16,000 soot particles per cubic centimetre, varying in diameter from 1·5 microns down, the average being about 0·7 to 0·8 micron. There were a few spherical particles and also a few drops of yellow oily-looking liquid, doubtless tar.

A dense record from 1000 cubic centimetres of air showed a number of dried-up stream beds blown out from the sides of the dust trace and formed by the water particles of the fog, and in the heads of these dried-up streams a large quantity of crystalline matter, in the form of skeletal crystals. The record itself was a thick, black line.

A microscope slide exposed from 4·37 to 4·55 P.M. and afterwards examined showed an extraordinarily rapid rate of settlement, the number of particles settling per square centimetre per minute at that time amounting to 80,000.

A cover glass exposed from 5·4 to 5·24 P.M. in the same way showed a deposit at the rate of 75,000 particles per square centimetre per minute. These particles were not water drops but solid matter and varied in size from about 1·5 microns down. There were a few small spheres. Most of the particles were in the form of aggregates, but very few showed any indication of having been held in the water drops. There were a few scattered particles, apparently crystalline in structure, and about 1·5 microns in diameter, which formed the centre of groups of smaller particles, suggesting the dried-up site of the impact of a drop. The formation of aggregates and the entire absence of wind may be the cause of the exceptional rate of settlement, as the number settling was much greater than would be accounted for by the normal deposit of particles of a diameter of about 1 micron.

On Monday morning the leaves and twigs in the hedges were covered with thick hoar frost which was brown in appearance. A slide left out overnight was covered with ice which, when melted, gave a pool of black water; the roads were coated with a dark scum which, on the pools of water, showed as an iridescent oily-looking film. It is very obvious that we were getting the London smoke in almost as great quantity as in a moderate London fog.

It would be of interest if any readers of NATURE living between south and west of London observed the phenomenon of this black deposit or discoloured ice crystals.

J. S. OWENS.
Advisory Committee on Atmospheric Pollution,
47 Victoria Street, Westminster, S.W.1,
January 14.

The Discovery of Argon.

SIR J. J. THOMSON'S reference to the discovery of argon, in his review in NATURE of December 6 of the life of Lord Rayleigh, will be read by chemists with surprise but without conviction, and though his comments upon chemistry must be received with the respect due to a late president of the Royal Society, they must also give rise to a certain amount of amusement. It is, however, with positive pain that many chemists have read Prof. Armstrong's letter upon this subject published in NATURE of January 10. What does he mean by "behind the scenes" and "Ramsay and his ways"?

As to the award of the medal, Prof. Armstrong omits to refer to Lord Rayleigh's speech on receiving it. This is printed in the Proceedings of the Chemical Society, from which I quote as follows: "Lord Rayleigh, on receiving the medal, said that, in returning his thanks to the Society, he was somewhat embarrassed, because he felt that there ought to be another standing by his side . . the credit for it must be

shared equally between Professor Ramsay and himself In some quarters there had been a tendency to represent that antagonism existed between chemists and physicists in the matter, though such a thought had never entered his head Professor Ramsay was a chemist by profession, while he himself had dabbled in chemistry from an early age, and had followed its development with very keen interest "

I returned from France to Ramsay's laboratory as an assistant in the autumn of 1894, and the first words he said to me, after shaking hands, were, "Well, it is a new gas" From April 1895 I was daily associated with him for years, and I have heard the early history of the discovery told many times This I know for a fact. when Ramsay communicated his preliminary results to Lord Rayleigh, he placed them at his disposal, but Lord Rayleigh was equally willing to allow Ramsay to go forward with the work alone I do not believe that either of these two great men ever felt the slightest regret that the discovery was shared As a matter of fact, if neither of them had discovered argon their reputation would be scarcely less enduring

Even during the preliminary stage, there were attempts to disturb the friendly relations between the two discoverers A well-known chemist called on Ramsay, and after being shown everything, after the manner of Ramsay, went home and wrote to Lord Rayleigh, telling him that he must place no reliance on Ramsay's work Lord Rayleigh sent the letter on to Ramsay, with a brief comment, which Ramsay passed on to the author Later the "Suum cuique" letters in the *Chemical News* showed chemists that there were people in their ranks capable of the most unworthy actions

However, Ramsay, when alive, knew well when to meet and reply to criticism, and when to "Lat them say." Ramsay, dead, will not suffer from attacks directed from "behind the scenes", but it may be hoped that the pages of NATURE will not be open to those who would discredit him in this manner

MORRIS W. TRAVERS

147 Queen Victoria Street,
London, E C 4, January 12

The Possibility of reproducing the Electrical Conditions of the Nitrogen Afterglow.

IN a paper by Johnson and myself (Proc Roy Soc A, vol. 106, p 200) on the effect of argon on certain spectra, attention was directed to structural modifications induced in the CH band, λ4315, and in the CN bands, these being similar to changes observed by Strutt and Fowler (Proc Roy Soc A, vol 86, p 116), when these spectra were stimulated in the afterglow of nitrogen In a recent paper by Johnson (*Phil Mag* vi, vol 48, p 1069) further evidence has been adduced for the similarity of the electrical conditions obtained in the afterglow to those existing when mild uncondensed discharges are passed through high-pressure argon In particular, an energy displacement in the first positive band spectrum, as developed in a tube containing a little nitrogen in the presence of high-pressure argon, was regarded as the analogue of the selection of three of the more refrangible heads in the several groups constituting the visible spectrum of the afterglow The energy displacement was related quantitatively to the percentage of nitrogen in the nitrogen-argon mixture If the analogy can be sustained, it should follow that the intensity maximum in the several groups of the afterglow spectrum will be displaced a little towards the violet end as the afterglow is dying away (that is, as the percentage of activated molecules diminishes).

To test this, the spectrum of the afterglow has been photographed through a neutral wedge at two points about 7 inches apart in a glass tube, through which a stream of glowing nitrogen was pumped Owing to the comparatively small light gathering power of the spectrograph, photographic exposures of 16 and 40 hours respectively were necessary, and even then the intensity was insufficient to permit of quantitative measurement of the plates A close comparison, however, indicated no pronounced energy displacement

Attempts have also been made to reproduce the β-group of the afterglow spectrum from discharge tubes containing nitrogen and argon, but no positive results have been obtained Incidentally, I have examined the spectrum of the light from discharges through ammonia in high-pressure argon, in the hope of obtaining the spectrum of the afterglow when atomic nitrogen (arising from the destruction of the NH_3 molecule) returned to the molecular state There was no evidence, however, of either the characteristic α or β groups occurring

I have also excited the band spectrum of iodine in the presence of high-pressure argon, but did not observe the relative intensity changes which Strutt and Fowler record as characteristic of the development in the afterglow

It would appear, therefore, that while there remain several points of resemblance between the electrical conditions of the afterglow and those existing when a mild discharge is passed through high-pressure argon, there are many specific effects of the former which are incapable of reproduction in the latter case

W H B CAMERON

The Queen's University, Belfast,
December 22, 1924.

Science and the Community.

THE article under this title in the issue of NATURE of January 3 refers to the small part played by scientific men in public affairs and in business life I think that the explanation of this is simple One man has a fixed amount of daily energy If he makes a great effort in one direction his effort in another direction is correspondingly weak, and so, in general, one man cannot excel in more than one direction

Now a successful business man, or, even more so, a politician, owes his success almost entirely to his powers of divining the wishes and thoughts of that strange creature—man A man of science, however, is dealing with an inanimate world which cannot be influenced by tact, persuasive powers, or individuality. Consequently, in general, those personal qualities and mental characteristics which lead a man to success in business have no relationship at all to those which lead to success in scientific work In fact, the inexactitudes and tactful misrepresentations characteristic of the business and political world are excessively distasteful to a man trained in the clear honesty and rigour of scientific thought, and put him at a positive disadvantage compared to his commercial fellow-man when engaged upon delicate negotiations of any sort

In general, a man who has worked for years studying physics and higher mathematics will be much less tactful and much less persuasive, and will probably be a worse judge of character, than a man who has spent an equally strenuous number of years in persuading people to buy something which they do not really need

GEOFFREY MARTIN.

Rosherville Court, Burch Road,
Gravesend, January 5.

The Propagation of Wireless Waves of Short Wave-length round the World.

By Dr J A FLEMING, F R S.

QUITE the most important of the pronouncements of the past year in connexion with wireless telegraphy were the two addresses given by Senatore Marconi to the Royal Society of Arts, London, in July and December, and also a paper by Sir Joseph Larmor, in NATURE of November 1, and the *Philosophical Magazine* for December last, on the theory of wireless transmission round the world Senatore Marconi gave details in July of his remarkable achievements with electric waves of relatively short wave-length, and in December of his discovery that waves of only 30 metres in length, or about 100 ft, can be used for reliable communication by day as well as by night over any distance, even to the antipodes, although entire continents and mountain ranges intervene (see NATURE, September 6, p. 359, and December 27, p. 939). In this most important advance, he has certainly priority of achievement, as he had in 1901, in long-wave transmission across the Atlantic When in 1902 Senatore Marconi discovered the great difference in range between day and night transmission with long waves across the Atlantic, it at once became clear that wireless transmission involved not only the ether of space round the earth, but also that the atmosphere itself, and especially, its state as regards illumination by sunlight, had a great deal to do with the matter

In the years that followed, radio engineers came to the conclusion that the best prescription for achieving regular commercial radiotelegraphy at all times of day and night over long world-distances was by increasing the wave-length and power Hence between 1902 and 1922 the demand for long distance radiotelegraphy involved the erection of large high-power all-round stations with great aerials sending out electric waves 30,000 to 60,000 ft in wave-length, and using power from 500 to 1500 horse-power or more The latest example is the 1000-kilowatt British Government radio station now being erected at Rugby.

The inhabited land area of the world being chiefly confined to one-half of the terrestrial globe, and the useful long wave-lengths being included within somewhat narrow limits, it is clear there is not an unlimited possibility of putting up all-round super-power radio stations without risk of interference

Accordingly, so far back as 1916, Senatore Marconi began to consider the alternative of exploring the utility of the other extremity of the wireless spectrum or gamut of wave-lengths, and using waves more nearly 100 to 300 ft in wave-length projected as a beam by skeleton parabolic mirrors of vertical wires. It was well understood that when using such mirrors, the wave-length employed must be less than the aperture and height of the mirror, and constructive difficulties placed a limit on the mirror dimensions Hence for beam projection short wave-lengths were essential In 1916, experiments were conducted by Marconi in Italy with such short-wave beam radiotelegraphy for war purposes, and later in England, with the able assistance of Mr C S. Franklin, important results were obtained in radiotelephony by 15-metre waves between London and Birmingham The achievements between 1916 and 1922 described in published papers by Senatore Marconi and Mr Franklin in 1922, amply demonstrated the practical value of these short waves of 100-metre wave-length or less In 1923, a series of tests by Marconi and his assistants on his yacht over long world-distances showed that communication could be established by these waves from Poldhu to Australia, but that the 100-metre wave had a markedly greater range by night than by day

In October of 1924, Marconi discovered that the daylight range increased very rapidly as the wave-length was reduced from 100 to 32 metres, or say from 300 to 100 ft ; and that perfect communication could be established for all hours of the day and night between England and Australia by the 32-metre wave when using only 10 or 12 kilowatts (say 15 h-p) in the transmitter

Apart altogether from the immense practical importance of this discovery, it raises scientific questions of high interest as to the mechanism by which these waves travel round the world It is now quite clear that normal wave diffraction is not sufficient The signal strengths at large world-distances are thousands of times greater than they could be by mere diffraction It is generally agreed that the effect must be due in some way to ionisation of the high-level atmosphere, which descends to a lower level during the day-time. Although many theories have been put forward, the important paper by Sir Joseph Larmor, above mentioned, throws fresh light on the subject. When an electric wave passes through ionised air it sets the ions in vibration If the ions collide at once with gas molecules, energy is dissipated and the wave is weakened

If the mean free path of the ion is long (say 10 times) compared with the distance the ion is moved by the wave in the periodic time of the wave, then there will not be much dissipation of energy but the effective dielectric constant of the medium will be reduced and the wave velocity increased

Larmor shows that at a certain height in the atmosphere, there is a region in which this accelerated and slightly dissipated wave energy can travel, and that a comparatively small ionic density will be effective. His equations show that the increase in wave speed depends on the ionic density and the square of the wave-length, and the modulus of absorption of the wave energy on the product of the ionic density and wave-length

The increase in speed of the upper part of the wave front causes the wireless ray to curve round the earth, and Larmor specifies the conditions which must be fulfilled for the required curvature to be produced.

It appears, then, that for a given ionic density the long waves are more absorbed than the short, but the long waves have more energy at starting Each wireless ray has its own proper path in the ionised air in travelling from the transmitter to any receiver The shorter waves travel at a higher level in the atmosphere where the ionic density is greater and more constant, and this compensates for the smaller wave-length in giving the required ray curvature and makes them less affected by day and night variations. The

longer waves travel chiefly in a region in which the ionic density varies very much between day and night and are thus less absorbed by night

In a general way, therefore, the theory fits in with facts, but there are an immense number of well-known wireless wave effects which will require consideration and discussion before we can say we can account for them all on any theory Meanwhile, the practical consequences of the discovery of the properties of this 32-metre wave are very great

Is there, for example, any justification for creating new high-power all-round radio stations by which the communication is, so to speak, bellowed over the world on 20,000-metre waves, when on the beam system perhaps a dozen stations could be erected for the same capital and annual working cost, which would whisper their message on 32-metre waves along limited paths, taking up much less room in the ether? Time, and perhaps expensive experience, will show whether the all-round high-power station is necessary In any event, the short-wave system has the enormous advantage that the receiving appliances used in connexion with it are vastly more immune from atmospheric disturbances and render all-day and all-night intercommunication possible over long distances, even up to the antipodes

The Oldest Fossil Fishes.

By Sir ARTHUR SMITH WOODWARD, F R S

IT has long been known that the fishes of the Downtonian age—the earliest fishes of which we have any real knowledge—are very different from those which appeared in later times and persist in part to the present day Prof Johan Kiær, of the University of Christiania, discovered fossil fishes in the rocks of this period in southern Norway a few years ago, and the first part of his memoir describing them has recently been issued.[1] Prof Kiær's remarkable specimens add greatly to our knowledge of these fishes, and some of his conclusions are so unexpected that they are of extreme interest to both zoologists and geologists

It appears that the Downtonian rocks of the Christiania region closely resemble those of Great Britain, and similarly contain the fishes in association with crustaceans and eurypterids in a good state of preservation They are shallow water deposits, with frequent traces of ripple marks and sun cracks, and Prof Kiær thinks they must have been formed in freshwater lakes on flood-plains Some of the fishes are familiar, such as the beautiful Cephalaspidian reproduced in Fig 1, which differs little from Cephalaspis itself except in having two dorsal fins instead of the single one All, indeed, belong to known groups, and all are as usual small, none being more than two decimetres in length The most striking novelties are referable to the Anaspida—laterally compressed fusiform fishes which were first described by the late Dr R H Traquair from the Downtonian rocks of southern Scotland—and Prof Kiær begins by devoting attention to the three new genera which he finds among these

FIG. 1.—*Aceraspis robustus*, Kiær Nearly complete specimen, nat size The foremost part of the head is incomplete From "The Downtonian Fauna of Norway"

In the original Scottish specimens, Dr Traquair was unable to make out any definite features in the head, and until he obtained examples with the heterocercal (or primitive unequal-lobed) tail, he felt uncertain as to which were the dorsal and ventral borders respectively In the new Norwegian specimens Prof Kiær has been more fortunate in finding both the head and the tail well preserved, and it now appears that the Anaspida differ from all other known heterocercal fishes in having the tapering end of the body bent downwards instead of upwards (see Fig. 2) Dr Traquair indeed described all his specimens upside down We have for the first time among fishes a form of tail which is known among the extinct marine reptiles, the ichthyosaurs, mosasaurs, and certain Jurassic crocodiles. Prof Kiær, following Schmalhausen, supposes that this arrangement is correlated with the position of the centre of gravity of the fish

The roof of the skull, which led to the discovery of the anomaly in the tail, is also very interesting. So far as it affords a clue to the underlying soft parts, it agrees with the cranial roof in the contemporary and allied cephalaspidians As shown in Prof Kiær's outline restorations (Fig 3), the large orbits are distinct, not far apart, and each is surrounded by a hard rim Between them is a plate pierced by a perforation doubtless for the pineal body; and immediately in front of this is a larger median perforation which may

[1] The Downtonian Fauna of Norway I Anaspida, with a Geological Introduction By Johan Kiær *Vidensk Skrift I Mat-naturv Kl* 1924, No 6 Kristiania, 1924

be rightly interpreted as an unpaired narial opening The small dermal plates are symmetrically arranged and nearly on the same pattern in the three genera, but there is a tendency towards fusion into fewer and larger plates as shown in the three successive sketches *a*, *b*, *c* In side view (Fig 2) the cleft of the mouth is now seen for the first time in Anaspida, and it is bordered with large plates, at least in the genus here restored. In upper view (Fig 3) the cranial dermal plates pass gradually backwards into the scales of the body, but on the side (Fig 2) the limit of the head region is marked by a conspicuous oblique row of gill openings

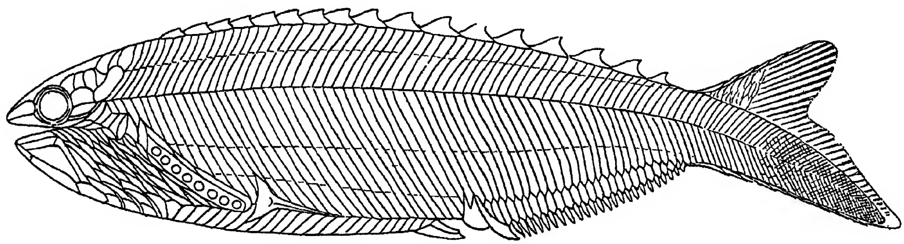


FIG 2—Reconstruction of *Rhyncholepis parvulus*, Kiær ×2. From "The Downtonian Fauna of Norway"

No traces of paired fins have hitherto been observed in these lowly forerunners of the fishes, but Prof Kiær finds in several specimens a small plate bounding the gill region behind, and a tapering spine which he considers to represent a pectoral fin (Fig 2) Behind this spine there are apparently sometimes a few fin rays Pelvic fins are entirely unrepresented Enlarged scales only mark the cloacal opening and arm the front of the anal fin

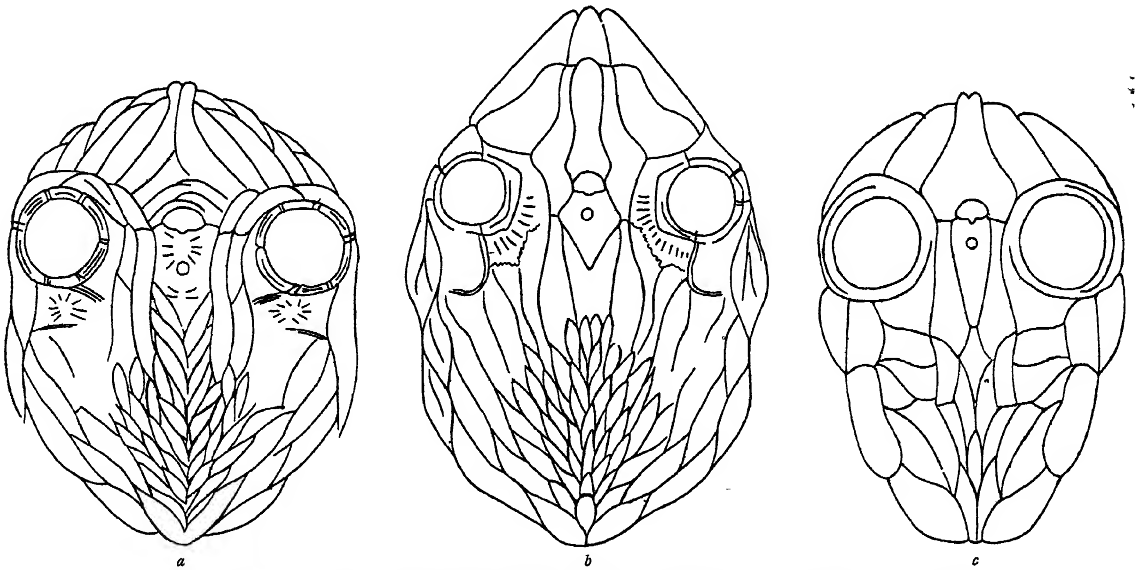


FIG 3—Cranial roof in schematic sketches of the Norwegian Anaspida *a*, Pterolepis, *b*, Pharyngolepis, *c*, Rhyncholepis From "The Downtonian Fauna of Norway"

There are many more interesting details, for which it must suffice to refer to the memoir itself Prof Kiær not only describes them, but also concludes with an exhaustive discussion of the affinities of the Anaspida as they are now understood Their anatomy, of course, can only be inferred from the hard dermal armature which is the sole part represented in the fossils The single median nostril and the relative proportions of the parts of the brain suggest that the late Prof E D Cope and others were right in regarding the earliest fishes as belonging to the same class as the existing lampreys and hag fishes Even Prof Kiær's discovery of evidence of ordinary jaws and rudiments of paired pectoral fins does not appear to him to invalidate this conclusion The lampreys, which are obviously degenerate members of their race, may well have lost the structures in question since the early geological period to which the Norwegian fossils date back. The Downtonian genera indeed represent the heyday of the class, when the higher fishes were only just beginning to appear

Prof Kiær is led finally into even wider speculations as to the origin of the paired fins in fishes He thinks the new discoveries indicate that a pair of pectoral fins appeared first, and then extended backwards as a paired fringe, of which eventually the pelvic fins were the sole persistent remnants There may be differences of opinion on these and some other inferences, but Prof Kiær's memoir is one of the most inspiring contributions to palæichthyology that has appeared in recent years, and we eagerly look forward to the promised continuation of it.

Biographical Byways.[1]

By Sir Arthur Schuster, F R S

4 Kirchhoff (1824–1887) and Bunsen (1811–1899)

In the controversies that excited at one time a good deal of feeling with regard to the part played by different men of science in establishing the principles of spectrum analysis, some confusion was caused by the ambiguous meaning of the word "analysis" The term may apply to the separation of the spectrum into its constituent homogeneous radiations, or it may denote a method to identify the constituents of a chemical compound by the light it emits when raised to incandescence To avoid the ambiguity, I introduced in 1882 the word "Spectroscopy," to indicate the physical side of this branch of science With regard to the use of the prism as an instrument of chemical analysis, there can be little doubt that Kirchhoff and Bunsen first demonstrated its practical importance, though Wheatstone had clearly indicated its possibility

I worked for one year with Kirchhoff at Heidelberg (1871–72) Those were not days of extensive and well-equipped laboratories Next to Kirchhoff's private study, in the building which served as his residence, one room only was available for advanced work Its chief occupant was Lippmann, who was working at his capillary electrometer. My table was by the side of his, and having placed myself entirely at Kirchhoff's disposal, he asked me to test an instrument he had devised for the study of metallic reflexion Nothing came of it, partly because the instrument did not prove suitable for the accurate study of elliptic polarisation, and partly because my measurements were not very good owing to the astigmatism of my eyes, which had not at that time been recognised The only other advanced student was Kamerlingh Onnes, who was experimenting with a pendulum designed to demonstrate the turn of the plane of vibration due to the rotation of the earth. He had to work in the lecture room next door There was only one other room, and that was used for elementary exercises One exercise was set aside for each week, and every student—about eight altogether—had a morning or afternoon assigned to him for carrying out the experiment There was one weekly lecture in which the results were criticised and the succeeding exercise explained

During my stay at Heidelberg, I was anxious to repeat an experiment I had previously performed on the spectrum of nitrogen There was no glass-blower in Heidelberg and no means of obtaining a Geissler tube Kirchhoff, to whom I appealed, advised me to consult Bunsen, who offered to let me use his laboratory, where I could find the necessary appliances I had to confess that I was not sufficiently expert in glass-blowing to make the tube myself He seemed rather amused, took me to a little room and spent the next half-hour at the blow-pipe When the tube was ready, further difficulties arose. Bunsen gave me a very inefficient induction coil and insisted on my using a bichromate battery, but he would not allow the zinc plates to remain in the solution for more than two or three seconds, watching me all the time I could not get a proper start and had to give up the experiment

There are always innumerable stories about Bunsen illustrating his absent-mindedness and simplicity of character. Many of them will be found in Roscoe's "Reminiscences."

I attended Bunsen's elementary lecture course, which began at seven o'clock in the morning during the winter and at six in summer, but one had to be in the lecture theatre well in advance of the hour fixed, because the time was taken from a very erratic clock in this room Whenever Bunsen was ready to start, he sent his assistant in to set the clock at six or seven as the case might be, beginning the lecture sometimes a quarter of an hour too early or too late by the real time

There could be no greater contrast both in appearance and manner than that presented by the two men. Kirchhoff, sharp-featured and always correct and precise · Bunsen, with the appearance of a prosperous farmer, and a somewhat cynical but at the same time good-natured smile New discoveries almost worried Kirchhoff they amused Bunsen. The effect of light on selenium happened to be first published when I was at home on a holiday, and on returning to Heidelberg I mentioned it to Kirchhoff His reply was: "I should not have believed that such a curious fact could have remained undiscovered until now." Kirchhoff's lectures were prepared with extreme care and delivered with precision He is reported never to have missed one during the tenure of his professorship at Heidelberg, but the record was certainly broken on one occasion. "I regret to announce," he said on a certain Thursday at the conclusion of one of his lectures, "that circumstances prevent my meeting you to-morrow." The "circumstances" were that he was going to get married, and the honeymoon lasted from Friday till Monday, when he was at his desk again.

When both men had retired and were nearing the end of their lives—one at Berlin and the other at Heidelberg—I occasionally went to visit them Kirchhoff's interests were confined to the days that were gone. He admired Maxwell for his work on the kinetic theories of gases "He is a genius," he said, "but one has to check his calculations before one can accept them" He admired Lord Kelvin for his vortex theory of matter "I like it," he remarked, "because it excludes everything else," and he added with a sigh: "If only it could explain gravitation." Bunsen liked to talk about new ideas "Tell me all about the experiments of Hertz," was his first remark on one occasion, and in spite of his almost complete deafness, he had a way of understanding when the subject interested him.

It may be worth while to record the scepticism of Bunsen with regard to the chemical identity of diamond and carbon. He considered the evidence to be insufficient, depending in great part on a single reaction of the gas produced in the combustion of the two bodies A more convincing test was the demonstration that equal weights of the two bodies produced equal weights of the products of combustion; but all depended here on the accuracy of the measurement, which probably was not very great My information came from Sir Henry Roscoe, who repeatedly alluded to it in conversation Engaged at the Cavendish

[1] Continued from p 89

laboratory on the spectrum of oxygen, I took the opportunity of placing a diamond inside a platinum spiral in an oxygen vacuum, and raising the spiral to a red heat by means of an electric current. The characteristic spectrum of an oxygen compound of carbon at once appeared, leaving no doubt as to the nature of diamond.

The examination for the doctor's degree at Heidelberg in those days was a purely oral one. The candidate was, in addition, supposed to send in a dissertation, but if this was not ready at the time of the *viva voce*, his degree was conferred on the latter alone, subject to the condition that he deposited a sum of money, which, so far as I recollect, amounted to 10*l*. This was returned if the dissertation was sent in and approved within one year. Three subjects had to be chosen; for example, physics, mathematics, and chemistry, of which one formed the principal and took up an hour. For the two others, half an hour was considered to be sufficient. The candidate, when ready, gave notice to the proper authority, and was in due course summoned to present himself on a certain day at seven or eight o'clock in the evening. No account was taken of attendances or period of study. Kirchhoff had the reputation of being a very strict examiner. When at the beginning of the year which I intended to spend at Heidelberg, I asked him how far I was expected to know the more mathematical branches of the subject, the only answer I got was: "I shall examine you in physics." All professors of the faculty received a fee for being present at the examinations, and the faculty of philosophy included all branches of arts as well as of science: this naturally secured a good attendance.

During my visit to Konigsberger, the examiner in mathematics, he told me that Kirchhoff was very fond of asking questions about the potential. This reassured me, as I felt pretty safe in that subject, but it turned out that the examination was all on optics. The candidate sat at a long table, surrounded by about twelve severe-looking individuals, most of whom were perfectly ignorant of scientific subjects. As I had not passed the "Abiturienten Examen," which is the school-leaving test, I had to submit to an additional examination in Latin; but the examiner told me, during my visit to him, that he would pass me however badly I did, and indicated the particular book in Cæsar's "De Bello Gallico" out of which he would ask me to translate a passage. I have a vivid memory of the mournful shaking of heads that went round the table when I translated "frumentum" with "Korn," which in German means "rye," instead of with the proper word which is "Getreide." An hour's *viva voce* can, of course, cover a good deal of ground, for, as soon as the examiner is satisfied that the candidate can answer a question satisfactorily, he at once passes on to another. After the first hour, a quarter of an hour was spent on light refreshments consisting of wine and cakes, and then the examination in the two secondary subjects began. Finally, the candidate was asked to withdraw, and after a few minutes' interval the result was announced to him. If successful, he was summoned to present himself to the Pro-rector next day. The degree was actually conferred after he had delivered an oath in Latin promising many things, one being that he would not take a degree at another German university.

All through the examination it appeared to me that the examiners rather took the part of advocates of the candidates against the gallery of dummy professors who were paid to be present. When I got into a muddle with Kirchhoff over a question involving the wave surface and he had not spotted my mistake, he only said, "We both have been rather stupid over this," and then started another subject. When I could not answer one of Konigsberger's questions he said: "There is no need for you to know this; I only asked you on the chance." As a matter of fact, I did know it, but failed to recognise the German expression which he used.

While I was considering the subject of my promised dissertation, I happened to meet the chief librarian of the university, who expressed the hope that I would default, for the reason that the forfeited deposits became the property of the University Library, which depended on this form of revenue.

Obituary.

DR. G. D. LIVEING, F.R.S.

BY the death of Dr. George Downing Liveing shortly after his ninety-seventh birthday, the University of Cambridge has lost the last of that small band of men who some sixty years ago set on foot the movement which proved the foundation of the present science school in that University. He was the eldest son of Edward Liveing, of Nayland, Suffolk; entering at St. John's College, Cambridge, in 1847, he was classed as eleventh wrangler in 1850, and as the first among the six who took the Natural Sciences Tripos in 1851, the year of its creation. After a short period of work under Rammelsberg in Berlin, he became a fellow and lecturer at St. John's College in 1853. In 1860 he married Catherine, daughter of the Rev. R. Ingram, of Little Ellingham, Norfolk, and thus automatically vacated his College fellowship in accordance with the old University statutes; in the same year he became professor of chemistry in the Military College at Sandhurst, but continued to teach in the St. John's Laboratory.

The Rev. James Cumming, F.R.S., occupied the chair of chemistry from 1815 to 1861, and Liveing, who had acted as deputy during the last two years of Prof. Cumming's life, was elected into the chair in the latter year. Liveing retired from the professorship in 1908; the University then conferred upon him the honorary degree of Sc.D. and appointed him an emeritus professor. He had been a professorial fellow of his College since 1880 and was elected into a fellowship again in 1908; in 1911 he became president of St. John's College. For many years he held the responsible and confidential office of Chancellor's secretary, an honorary official whose duty consisted in keeping the Chancellor of the University informed on all material happenings. In addition he served for long as a Borough and County Justice of the Peace, and was punctilious in the performance of his magisterial duties.

On his return from Germany in 1852, Liveing conceived the idea of providing instruction in practical chemistry for the medical students; no chemical laboratory existed in the University and one was equipped in a cottage on the west side of Corn Exchange Street, the fittings being improvised and oil and spirit lamps being used in default of gas St John's shortly afterwards built a small laboratory for Liveing, and this he used until long after he became professor in 1861 By this latter date, and largely as a result of the insistence of such progressive spirits as Liveing, the University had decided to build science laboratories, but the University was poverty-stricken, and for this and other reasons the oldest part of the present chemical laboratory was not built on the site of the old Botanic Garden until 1888 The difficulties which Liveing had to surmount in inaugurating a chemical school in Cambridge would have disheartened a man of less determination His stipend was 100*l* per annum, paid by the Government and subject to the deduction of Treasury fees amounting to four guineas As he has himself said, men in those early days had to devote their means as well as their wits to the service of the University Until his retirement in 1908, Liveing financed the chemical laboratory as a private venture, and he informed me that he declined to submit his accounts, when challenged in later years by the suggestion that he had been drawing a large revenue, because he was ashamed to disclose to his colleagues how large a sum he had thus contributed from his own resources.

Prof. Liveing lectured on heat as well as on chemistry, but in 1871 James Clerk Maxwell was appointed to the Cavendish professorship of experimental physics, a new chair established largely by the exercise of Liveing's influence Maxwell commenced to deliver the lectures on heat in the chemical lecture-room in October 1871 Later, Liveing espoused the cause of other new subjects in Cambridge; thus, he housed the beginnings of the present flourishing school of agriculture in his own laboratory, and protected and encouraged it until it became independent under the auspices of the Drapers' Company In a similar way he devoted his energies and money to the establishment of the Cavendish College, an institution for the accommodation of impecunious students This enterprise soon stopped for lack of funds, and the building is now the Homerton Training College for teachers

Prof Liveing was elected into the Royal Society in 1878, and in 1901 received the Davy medal for his spectroscopic researches—"one of the most valuable contributions to this department of chemical physics yet made by British workers" He joined the Chemical Society in 1853, two years before Roscoe, and shortly after his first paper appeared—"On the transmutation of the elements"—in the "Cambridge Essays," first series, for 1855; this little note is characteristic in its breadth of knowledge, its elegance in phrasing, and its economy of words A few short papers on geological and minor chemical subjects followed, and in 1878 began the great series of memoirs on spectroscopy in conjunction with the late Sir James Dewar, who had been appointed Jacksonian professor of natural philosophy in 1875 The close and intimate friendship which existed between Dewar and Liveing was very striking, both were men of strong personality, but no two men could have presented a greater contrast in outlook, tastes and all essential characteristics Yet each held the other in profound esteem, and neither ever said a word in criticism of his colleague, without this absolute loyalty, the happy collaboration of Liveing and Dewar could not have persisted for nearly fifty years.

Liveing's scientific eminence will repose on these joint spectroscopic papers; the skill which he displayed in the development of experimental methods and his infinite patience as an observer resulted in the collection of an enormous mass of accurate data concerning the spectra of the elements which is still in course of interpretation During his latter years Dr Liveing occupied himself with the publication in book form of these researches, the "Collected Papers on Spectroscopy," by Dewar and Liveing, was issued by the University Press in 1915 He read his last paper, entitled "The Recuperation of Energy in the Universe," before the Cambridge Philosophical Society on May 7, 1923, and was engaged on experimental work connected with certain ideas put forward in that paper until but a few weeks before his death

It is difficult to appraise the achievements of one, just passed away, who had left his student days behind him before Frankland had stated the doctrine of valency and before Kekulé had devised the structural formulæ of the chemist Liveing had been the personal friend of Dr Whewell, the great Master of Trinity, W H Miller, the founder of our present system of crystallographic nomenclature, Adam Sedgwick, Sir Joseph Hooker, Michael Foster, Sir Gabriel Stokes, Sir George Airy, de Morgan and Charles Darwin, he had studied under Rammelsberg, Mitscherlich, Rose and Magnus. He once mentioned to me that he and Hooker, after some preliminary discussion, walked over to see Darwin for the purpose of hastening the publication of the "Origin of Species," which appeared in 1859 In his conversation, always sprightly and vivacious, he seemed often trying to translate our later knowledge into terms of the science of seventy years ago; as befitted one who belonged to the age when the collection of facts was the main objective of science, he was apprehensive as concerned the vast theoretical flights of modern physics and chemistry Indeed, in his presidential address to Section B of the British Association in 1882, he expressed his distrust of the graphic formulæ of the organic chemist in terms which must be considered as vigorous, coming from one temperamentally so cautious in judgment and so moderate in expression In talking with Liveing and hearing his statement of long obsolete chemical views,

> "Told, when the man was no more than a voice
> In the white winter of his age, to those
> With whom he dwelt, new faces, other minds,"

one began to realise the difference between the science of seventy years ago and that of to-day, and to speculate as to what our survivors seventy years hence will think of the science of the future At the same time, and although an authority on the older chemical knowledge, Liveing always maintained an excellent appreciation of recent progress

Like many other men of robust habit and great vitality, Liveing found it difficult to understand why

his contemporaries dropped out and passed away, declining health seemed to him as due to lack of resolution He was an enthusiastic gardener, and when well past his ninetieth birthday engaged in all the manual toil incidental to the care of a large garden, after this work had become too heavy he took his exercise by walking, and, in fact, his last illness resulted from a collision with a cyclist His memory of long-past events was remarkably clear until quite recently, but he sometimes forgot that others could not reach so far back into the past, a few months ago, whilst still in full mental vigour, he expressed surprise that I had not noticed the splendour of Donati's comet—in 1858

Liveing shirked publicity and rarely spoke in the Senate House because, as he said, he feared being betrayed by provocation into expressing his views—formed with care and then held tenaciously—in terms which might flavour of exaggeration But whilst others wrangled, Liveing worked, and he will be remembered as the last of that small band of Victorians who possessed themselves of a secluded and conservative institution with splendid traditions and passed it to their successors as a great modern University A further reason for the rarity of his public utterances lay in the meticulous conscientiousness with which he carried out any duty undertaken; he attended every meeting of the numerous committees and councils of which he was a member, and the sheer labour which he devoted to the study of the questions concerned left him with little leisure or desire to influence others by the spoken word But the counsels of one so wise, so prudent and so experienced were often sought and were always given in careful and measured terms With the death of Prof Liveing, the University has lost one of its most devoted servants, science has lost a pioneer whose early work will long serve as a starting-point for fresh advances, and a great gentleman has passed away

W J POPE

MR W WHITAKER, F.R.S.

THE death of William Whitaker on January 15, though for some weeks it had been clearly imminent, will be felt none the less as a deep personal bereavement by his many friends The picturesque figure so familiar at the meetings of the British Association, the alertness in body and mind, even after fourscore years and more had laid their burden upon him, but, above all, the geniality which endeared him to all he met, will long be remembered As a geologist he was a pioneer in the elucidation of the Tertiary strata and the superficial deposits of the south and south-east of England, second only to Prestwick in that branch of the science

Born in London on May 4, 1836, Whitaker was educated at St. Albans Grammar School and University College, London At the age of twenty-one he was appointed to the Geological Survey, and continued in that service until 1896 His work lay almost wholly in the London Basin and in the neighbouring counties The original one-inch geological maps were largely the work of his hands, but he was indefatigable also in collecting records of artificial sections, wells, boreholes, and the other openings which abound in and around London His labours culminated in the production of the Geological Survey Memoirs on "The London Basin," "The Geology of London and Part of the Thames Valley," and other smaller works. These volumes form standard works of reference and provide the basis on which much of the later literature is founded

Among other records collected by Whitaker were those relating to the first deep borings that reached Palæozoic rocks under the Tertiary and Secondary strata of the south of England By their aid he was enabled to trace variations in the development of these strata and to sketch broadly the form of the Palæozoic floor and the distribution of the rocks forming it The possible existence and situation of concealed coal-fields had come up for consideration, and so long ago as 1889 he wrote ' that Coal Measures are likely to occur somewhere along the line of the Thames Valley, or in neighbouring tracts It is rash to attempt to foretell the future, but it seems to me that the day will come when coal will be worked in the south-east of England" ("Geology of London and Part of the Thames Valley," p 46)

Whitaker retired from his official post at the age of sixty, in order to pursue economic geology. As a consulting geologist on sanitation generally, and on questions of water-supply especially, he attained a high reputation. But he still took pleasure in rendering service to the Geological Survey A long series of memoirs on county water supplies from underground sources testifies to the diligence with which he collected records of wells and springs, and to the skill with which he interpreted them This work he continued almost up to the last

The history of the literature of geology occupied much of Whitaker's spare time For some years he made "The Geological Record" his especial care, and he also compiled many lists of geological books and papers relating to counties, a task that might have proved tedious to one of less pronounced bibliographical tastes Though much of his work was of this more or less statistical character, there stands to his credit a great record of original research In addition to the many official memoirs of which he was author or part-author, his papers on Subaerial Denudation, on the Chesil Beach, and on Water Supply from the Chalk may be selected for mention He was not given, however, to theorising and was never drawn into controversy

The high esteem in which Whitaker was held by his fellow-workers is shown by the offices he was called upon to fill and the honours he received. Elected to the Geological Society in 1859, he served on the Council in 1873 and many years after, as president in 1898–1900, and as vice-president, 1901–2 In 1886 he was awarded the Murchison Medal, and in 1906 was the second recipient of the lately founded Prestwick Medal, a particularly appropriate recognition of his work in the field in which the founder of the medal had laboured In 1923 he received the Wollaston Medal, the blue ribbon of British geology. He was elected to the Royal Society in 1887, and served on the Council in 1907–9 He presided over Section C of the British Association at Ipswich in 1895 and gave an illuminating address on the underground geology of that part of England. He was president also of the

Geologists' Association and of other societies. At the time of his death he was an honorary member of the Geologists' Association, of the Geological Societies of Liverpool, Manchester, and Yorkshire, of the Philosophical Society of York, of the Belgian Society of Geology, and correspondent of the Academy of Natural Science of Philadelphia

Whitaker made many a friend, but never an enemy Indeed, it is impossible to suppose that with so kindly a nature he could speak an unkind word To the younger generations of geologists he never failed to lay open his stores of knowledge, or to impart the enthusiasm with which he had himself been inspired The attainment of the truth was the dominant motive with him, and it gave him as much pleasure that it should be attained by others as by himself Unselfishness, transparent honesty, and kindliness were the conspicuous features of his truly lovable character

A. STRAHAN.

THE death on October 29 of Dr. Ernst Konig, of the famous dyeworks at Hochst-am-Main (formerly Meister, Lucius, and Bruning) at the early age of fifty-five, is recorded by the *Chemiker-Zeitung*. Konig's reputation rests securely upon his well-known researches in the field of photochemistry. Born at Flensburg in Schleswig, he graduated at the University of Leipzig, where for a very brief period he acted as assistant to Prof. Stohmann In 1893 he entered the service of the dyeworks at Hochst, where he eventually attained a position of the highest responsibility. At first he undertook the investigation of new coal-tar colours, but his chief interest lay in their application to photographic processes In 1902 a photographic department of the works was formed under his direction, and two years later a new kind of three-colour collodion process, the *pinachrome* process, was invented This was followed by the application of dyes to chromate-gelatin emulsions and the development of the *pinatype* process. He also devoted much attention to the production of various light-filters and desensitisers One of the most important of his discoveries was that of the panchromatic plate The problem of extending the region of sensitiveness of the emulsion beyond the yellow into the red and even far down into the infra-red region was solved by employing as sensitisers derivatives of quinoline, containing auxochromic groups in the benzene nucleus Konig was also the author of numerous scientific papers and books on photographic subjects.

WE regret to announce the following deaths.

Mr G Abbott, well known for his geological studies, and one of the founders of the South Eastern Union of Scientific Societies, on January 12, aged eighty

Right Rev L C Casartelli, Roman Catholic Bishop of Salford, and formerly president of the Manchester Egyptian Association, of the Manchester Egyptian and Oriental Society, and of the Manchester Statistical Society, and the author of numerous papers in oriental journals and in the proceedings of the Manchester Statistical and Geographical Societies, on January 18, aged seventy-two

Dr Clement Dukes, for thirty-seven years physician to Rugby School, and author of "Essentials of School Diet" and "School Health," on January 18, aged seventy-nine

Dr J McT. E McTaggart, fellow of Trinity College, Cambridge, since 1891, and the author of "The Nature of Existence," on January 18, aged fifty-eight

Dr Julius Morgenroth, a professor at the Robert Koch Institute for the study of infectious diseases in Berlin, and a former student and colleague of Paul Ehrlich, known for his work on immunity, on December 20, 1924, at the age of fifty-three

Current Topics and Events.

GREAT encouragement for industrial research is contained in a notification just made to the chairman of the British Cotton Industry Research Association to the effect that 65,000*l*. is to be received by the Association as an addition to its present income—most welcome aid towards the maintenance of the laboratories at the Shirley Institute, Didsbury The trustees of the Cotton Trade War Memorial Fund, acting on a recommendation from the Cotton Reconstruction Board, have decided, subject to the approval of the Board of Trade, to make this grant in instalments, 5000*l* for the year ending June 30, 1926, and 20,000*l* for each of the three years ending June 30, 1927, 1928, and 1929 Some four years ago the Cotton Reconstruction Board made a grant to the British Cotton Industry Research Association of 200,000*l*, a sum from which a large part of its income has ever since been derived, and the fact that the trustees have now decided to continue their help shows their great confidence in the ultimate benefits that will accrue to the cotton trade as the result of scientific research Nothing could more strongly signalise the value of science to the industry than a gift such as this, and their appreciation of what they describe as "the good work being carried out by the Shirley Institute" is bound to encourage not only the staff there but industrial research workers throughout Great Britain Further, they feel that this work should be made even more widely known to the trade and to the workpeople themselves, showing that the real importance of applied science is now being more fully realised. Thus the labours of chemists, physicists, botanists, and engineers on the fundamental problems presented by cotton are being justified.

THE Dominion of Canada, which extends in an irregular way on a 3000-mile base line, with a scattered population and cities widely separated, will benefit largely by radio communication. In accordance with the agreement made between the Marconi Co and the British Post Office, the Canadian Marconi Co has begun to construct a "beam" station in Canada for communication with the stations which the Marconi Co is to erect in England The transmitting station is being erected at Drummondville, 50 miles east of Montreal, where the main office is situated, and the receiving station is at Yamachiche, which is about the same distance from headquarters Both sections

will be operated from Montreal by a "remote control" method The work was begun last November, and although the temperature has often been 20° below zero and the workmen have to wear gauntlets to prevent frost-bite by accidentally touching metal, good progress has been made The transmitting aerials for communication to England are supported on five masts of steel lattice work and each is 300 ft in height For communicating with Australia, five 250-ft masts are employed The power required for each station per beam is 150 horse-power and is obtained from a local power supply company The power delivered to the anode of the valve required for each beam, however, is only about 25 horse-power Both the sending and receiving stations which are to be erected in England will be operated by remote control from the Central Telegraph Office in London When the stations are completed, Canada will be brought into much closer contact with England and with Australia It has been agreed to fix the rates so as to attract the largest volume of traffic It is hoped that in this way the trade between the Dominions will be fostered to the advantage of the British Empire as a whole

SIR WILLIAM BRAGG, in his Friday evening discourse at the Royal Institution on January 16, dealt with the investigation of the properties of thin films by means of X-rays The reactions of bodies must generally depend upon the nature and condition of the surfaces at which they meet, therefore the thin surface film is of great importance It may differ in structure, composition, or other condition from the internal portions of the body, and the fine vision of the X-rays may well help in its investigation. The X-rays cannot take notice of a single film or layer, their especial power lies in the measurement of the spacing of a set of layers But the general laws of arrangement which are discovered in the crystal must be applicable to the thin film, and in some cases the thin film may be looked upon as one single layer of a crystal Thus it has been possible to examine some elements of the structure of the fatty acids, alcohols, paraffins, and similar long-chain substances to measure the thickness of the layers in which they lie, and to confirm with numerical amendments the previous measures of Langmuir, Hardy, Adam, Perrin, and other workers It is found also that the fatty structure of these substances is shared by many more solid crystals, in which also the molecules lie more or less across the flake bound together by side-to-side ties which are stronger than those at the ends It is a general characteristic of crystalline structure, more particularly in the case of organic substances, that each molecule occurs in one or other of a small number of definite orientations and that a molecule of one orientation binds together molecules of other orientations. The characteristics and probably the strength of the crystal depend upon the fact It may explain the strength of the "black spot" of the soap film. the two layers of oleic acid on the two sides of the film are individually non-crystalline, but when they meet—the intermediate liquid being expelled—the full symmetry of the crystal can be realised, when all the orientations are present The flaky substances are often greasy because of the toughness of each layer and the ease with which they slide on one another, pressure and rubbing tend to encourage the formation of the flakes in such substances as stearic acid

SIR OLIVER LODGE delivered the second of his series of talks on the ether under the auspices of the British Broadcasting Company at 2LO on January 20, taking as his title "Vibrations and Waves and what they signify" Sir Oliver stated that the ether is so uniform that it as difficult for us to discover it as a deep-sea fish would find it difficult to discover water All knowledge has to make its way slowly and painfully against a mass of prejudice and inertia nevertheless it is better to be slow in accepting the truth than to be ready to accept falsehood a certain amount of opposition may be salutary. Meanwhile our theories do not alter facts the facts are there all the time, and are independent of what humanity thinks of them Some things we have learnt which were unknown to the ancients, but in time we too shall be ancients, and our descendants will wonder at the blindness and stupidity, even of our learned men We used to try to explain ether properties in terms of matter we now perceive that we must explain matter in terms of ether We now realise that the clue to the physical universe lies in electricity and magnetism We had thought that the way towards the light must lie in the open country of ordinary mechanics, we are now plunging into the wood—the forest of ether-dynamics But glimpses of illumination have been caught through the branches, and have heartened the younger generation of physicists with a great enthusiasm Those who have insight and intuition know that through this strangely unpromising country lies the road to reality.

ATTENTION is directed, in a leading article in a recent number of the *Scottish Naturalist* (December 1924), to a modern development in the protection of wild life in the United States of America The sportsman has entered into competition with the naturalist in the race for the creation of animal sanctuaries The reason is obvious The development of American legislation for the protection of wild animals shows very distinctly that a progressive disappearance of sporting mammals and birds has been proceeding for many years The result is that, in the words of the Hon John W. Davis "Hunting is fast losing its character as one of the most democratic of sports The really good shooting-grounds are rapidly being taken up by clubs too expensive to be patronised by the average sportsman Drainage of great marsh and swamp areas, the natural breeding- and feeding-grounds of wild fowl, has threatened these with extinction. We must establish shooting-grounds so that the man of average means may enjoy the ancient, healthful, and democratic pastime of shooting, and *we must have the refuges if we are to continue to have the wild fowl*" Accordingly a "Game Refuge Bill" has been introduced into Congress with the whole-

hearted support of the American Game Protective Association and of sportsmen generally The combination of sportsmen and naturalists in an endeavour to protect wild life is a movement of great significance, for, as the *Scottish Naturalist* points out, "the sanctuary is the best solution of the problem of the preservation of the native fauna"

A REPORT on excavations at Ur by the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania since November 1, when the season's work began, appeared in the *Times* of January 14 The main object of the work this year will be to discover whether the great ziggurat or tower was an isolated structure or formed part of a more considerable complex Excavations to the north-west of the tower, between it and the enclosure wall, have brought to light living quarters and store-rooms of the priests of the Persian period which overlie a courtyard laid out by Nabonidus Beneath the latter was a range of buildings dating from the 16th century B C, and beneath this again were the walls of shrines erected by the kings of Isin and Larsa (*c* 1600 B C) Underneath this stratum was found the terrace wall of Ur-Ungur, the builder of the ziggurat Inscribed nail-shaped cones of fired clay were found driven into the wall, this being the first indication ever found of the use of these objects On the south-east side of the ziggurat a "Hall of Justice" has been brought to light, a structure originally a triple gateway, of which the back door had been blocked up by a later cross wall Mud-brick chambers had been built alongside, in or on the ruins of the double wall in which the gate tower had originally stood An inscription on a gate socket records the restoration of the fallen tower about 650 B C The original gate has yet to be discovered. It is known that it had been repaired by Ishme-dagan of Larsa by 2000 B C

AFTER an exhaustive inquiry by a commission which visited Europe, Japan resolved in 1921 to make the metric system of weights and measures compulsory throughout the Empire and took steps to secure a primary standard metre for the country On the advice of Prof Nagaoka, it was decided to obtain interference apparatus similar to that used by Benoit, Fabry, and Perot, who found that the red line emitted by cadmium vapour had the wave-length $0\,64384696 \times 10^{-6}$ metre According to a memorandum by Mr F Twyman on the measurement of standards of length in wave-lengths of light, the apparatus has been constructed by Messrs Hilger, and in the course of his study of the literature on the subject of the metre, Mr Twyman has noted how isolated the British are becoming in adhering to the yard as the standard of length, and how little is known about this standard to the degree of precision at present attainable The British Empire, the United States, China, Paraguay, and Turkey appear to be the only countries in which the metric system is not now compulsory, and there appears every likelihood of China adopting the system in the near future.

KNUD RASMUSSEN, the Danish explorer, has been awarded the Charles P Daly Gold Medal of the American Geographical Society for 1924 for his explorations in Greenland and northern North America For twenty-five years he has studied the life of the Eskimo and explored northern lands An account of his work and that of his assistants on the second *Thule* Expedition has appeared in the *Geographical Review* (vol 8, 1919, pp 116-125, 180-187). His latest expedition—the so-called fifth *Thule* Expedition—occupied three years, and the field of his work included the whole stretch of territory between Greenland and Siberia, as well as the study of the folklore, language, present distribution, migrations, and particularly the foci of migrations of all the known Eskimo tribes and families The results will be issued in a series of volumes and maps Among the most noteworthy of Rasmussen's earlier publications are "Greenland by the Polar Sea," "Eskimo Folk Tales," and "The People of the Polar North"

THE *Indian Antiquary*, which has been conducted by Sir Richard Temple as editor-proprietor for more than thirty years, has been transferred to the Royal Anthropological Institute and is being published by that body under the authority of its Council as from January 1 It will continue under the joint editorship of the present editors, Sir Richard Temple and Mr S M Edwardes, with S Krishnaswami Aiyangar as Indian editor. In policy and scope the *Indian Antiquary* will remain unchanged, and will continue to deal with the history, ethnology, archæology, linguistics and folklore of India The Council of the Royal Anthropological Institute has authorised the formation of an Indian Section of the Institute the function of which will be to afford a meeting-place for discussion among those in Great Britain who are interested in the anthropology, archæology and history of India, to correlate the results of research in these subjects, and also to co-operate with workers in India The *Indian Antiquary* will serve as the official publication of this Section and in it the proceedings of the Section will appear

PROF BOHUSLAV BRAUNER, professor of chemistry in the Charles' (Bohemian) University at Prague, has been awarded the cross of a chevalier of the French Légion d'Honneur for his scientific work in chemistry.

DR. ALEXANDER WETMORE, of the U S Biological Survey, has been appointed superintendent of the National Zoological Park, Smithsonian Institution, Washington, in succession to Mr N Hollister, who died on November 3

THE Tokyo correspondent of the *Times* announces that Mr Rockefeller has made an unconditional gift of four million yen (400,000*l* at par) to the Imperial University Library It will be remembered that in the fire which followed the earthquake of September 1, 1923, the Library of some 700,000 volumes was destroyed

WE have received the annual report and statement of accounts for 1923–24 of Livingstone College,

Leyton The College was founded thirty-two years ago for the purpose of training missionaries in the elements of medicine, and 810 students have taken its courses of instruction during that period The deficit has been reduced by about 42*l* during the year, but it still amounts to 1067*l*, and further donations and subscriptions will be very welcome

ON Tuesday next, January 27, at a quarter past five, Dr H R Hall will deliver the first of two lectures at the Royal Institution on the relations of the prehistoric Greek and ancient Egyptian civilisations, and on Thursday, at the same hour, Sir William Bragg will begin a course of four lectures on the properties and structures of quartz The Friday evening discourse on January 30 will be delivered by Prof J W Gregory on the mountain structure and geographical relations of South-eastern Asia, and on February 6 by Prof. R W Chambers on the earliest recorded kings of the English

THE first presentation of the Rivers Memorial Medal for anthropological work in the field, founded by the Council of the Royal Anthropological Institute in memory of the late Dr W R Rivers, will be made at the anniversary meeting of the Institute to be held at the London School of Economics on January 27, at 8 30 As already announced, the first award of the medal has been made to Dr A C Haddon, in recognition of his work in New Guinea, Torres Straits, and Borneo After the presentation, Prof C G Seligman, president of the Institute, will deliver his presidential address on "Some Little-known Tribes of the Southern Sudan"

IN connexion with the recent celebration of the bicentenary of Sir Christopher Wren, the Royal Institute of British Architects published a book on Wren and his work (including St Paul's Cathedral), entitled "Sir Christopher Wren Memorial Volume · 1723–1923" The profits of the sale are devoted to the St Paul's Preservation Fund The sale of only one thousand copies of the five guineas edition would enable the Institute to hand over a sum of 2000 guineas, which would be acknowledged in the *Times* list in the name of each purchaser as a subscriber of two guineas Orders, enclosing remittance, should be sent to the Librarian, R I B A, 9 Conduit Street, London, W 1

A PROCESS of direct colour photography is recorded by A Hoffmann (*Photographic Abstracts*, iv 139), who found that when photographing on a chloro-bromide transparency plate, objects reflected from the surface of a lake were rendered in their natural colours on prolonged development with pyrogallic acid The angle of reflection proved to be the polarising angle The author found that by using a grainless emulsion of Valenta's formula and exposing with a black glass reflector in front of the lens, on development with 0 1 per cent pyrogallic acid with relatively large proportions of ammonia and potassium bromide, images in very good natural colours were produced

AN investigator at the mines department testing station at Eskmeals, Cumberland, is shortly to be appointed, and applications for the post are invited. The duties of the person appointed will be to carry out, under the direction of the superintending testing officer, experimental work on problems arising in the testing of safety lamps (flame and electric), the analysis of mine air and mine dust, etc, and to assist the testing officer generally in carrying on the scientific work of the station Applicants must possess good scientific qualifications and have had experience in analytical and experimental work of this character Forms of application, which must be returned not later than January 31, can be obtained from the Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1

THE Scientific Expeditionary Research Association dispatched the *St George* last April on a year's cruise to the Southern Pacific with the object of exploring many of the lesser-known islands and reporting on their natural history, ethnology, botany, marine life, etc An account of the work which has been accomplished was given in our issue of November 8, 1924, p 681, by Mr J Hornell, the scientific director of the expedition It was intended to complete the cruise by studying the little-known islands south and east of Tahiti, but owing to unforeseeable circumstances, the funds are no longer available Unless about 9000*l* can be raised at once, it will be necessary to recall the *St George* at what will be the most valuable and promising point of her voyage An appeal has accordingly been issued, signed by ten members of the Advisory Council, representative of various branches of natural science, archæology, and so on, six of whom are fellows of the Royal Society Subscriptions should be sent to the secretary of the Association at 50 Pall Mall, S W 1

THE work of the Smoke Abatement League of Great Britain, established in 1909, was dropped during the War and was not taken up again until 1923 Now the League is preparing a great campaign against the smoke nuisance and, with this object in view, is appealing for increased membership and support We learn also that the valuable papers which were presented at the Manchester Smoke Abatement Conference held in November last under the auspices of the League, together with the discussions, are to be issued shortly in book form Particulars of the League's activities can be obtained from the honorary secretary, Mr C Elliott, 33 Blackfriars Street, Manchester

A VERY interesting and instructive catalogue (pp iv + 24) of industrial sands has recently been issued from the Westmoor Laboratory, Chatteris, by Mr A L Curtis, who for twenty years has specialised in supplying tested sands, and also clays and refractories, for technical and commercial use It will be a revelation to many that the particular requirements of manufacturers and contractors can be met by so many different kinds of natural and artificially-prepared sands The pamphlet describes more than fifty varieties used for widely different industrial purposes such as glass and pottery manufacture, sand-blast and other abrasive processes, moulding and casting, furnace lining, filtering, cement making

and testing, and less familiar applications in the soap and paint industries Mr Curtis has accumulated an enormous mass of data relating to the properties and uses of sands, and he undertakes to advise his clients on the problems that arise Apart from his commercial enterprise, he is to be congratulated on issuing a pamphlet of unusual educational interest

THE fourth Annual Report of the Animal Breeding Research Department of the University of Edinburgh is a record of research work actively pursued in many directions under the guidance of the director, Dr. F A E Crew The Department is engaged on the problem of wool improvement in Welsh sheep, with special reference to its kemp content, with the object eventually of eliminating this undesirable element from the fleece. Hybridisation experiments by crosses with Peruvian merino sheep are also being carried out with the object of improving British wools, and this has necessitated a detailed microbiological investigation of the fibres comprising the fleece of sheep. Parallel investigations on the fecundity, fertility, sterility, and general physiology of fertilisation in sheep are in progress and promise results of great importance The list of twenty-one papers issued from the Department in the course of the nine months covered by the report is an eloquent witness to its widespread activities and to the value of the work being carried on there

WE are informed that Messrs Gurney and Jackson, 33 Paternoster Row, have been appointed official publishers to the Faraday Society, and in future they will deal with all business relating to the sale of Transactions and separate Reports of General Discussions

WE have received from Messrs Negretti and Zambra a specimen of an ingenious and simple pocket forecaster The instrument consists of three concentric circular discs, the largest of which is two inches in diameter The instrument is set by first rotating the middle disc so as to bring an arrow on it into coincidence with the appropriate point on a wind direction scale engraved on the outer disc, and then rotating the inner disc so as to set an arrow over the appropriate reading of a barometer scale in inches graduated on the middle disc The inner disc has three windows, one each for rising, steady, and falling barometer, fitting over a series of code letters A to Z. Through the appropriate window a code letter is read, and this letter selects one of 26 forecasts given on the back of the outer disc The instrument is ingeniously conceived, and can be recommended to those who desire to make the most of their barometer, with the proviso that no simple instrument can be expected to be infallible in dealing with so complex a phenomenon as the weather On the whole, it may be expected to give good results

Our Astronomical Column.

WOLF'S COMET —A Copenhagen telegram announces that Prof Wolf succeeded in photographing this very faint comet again on January 13, at $17^h 58.5^m$ G M T (new), its position for 1925·0 being R A $4^h 4^m 48 0^s$, N Decl 20° 14′ 54″ The Right Ascension was about $1^m 27^s$ less than Kahrstedt's ephemeris, the Decl 12′ greater The orbit elements therefore need considerable modification, but there has not yet been time to do this The magnitude had declined from 16 to 17, so it is to be feared that the object will not be visible for very long.

MINOR PLANETS —*Astr Nachr*, No 5341, contains a paper from the Berlin Recheninstitut describing the discovery of minor planets for the period July 1, 1923, to June 30, 1924 The number of discoveries is unusually large, 108, and shows that we are far from exhausting the zone Only 29 of these were sufficiently observed for trustworthy orbits to be calculated and to receive permanent numbers The numbers assigned are 996 to 1024, so that the 1000 mark is now well passed No 1023 is named Thomana, the others are still unnamed The highest inclination among the new planets is 26° 58′ (No 1019), the lowest 0° 41′ (No 996) The greatest eccentricity is 0 454 (No 1009), the smallest 0 009 (No 1020) The periods range from 2 64 years (No 1019) to 6 25 years (No 1004) A new plan for the provisional numeration of planets is adopted in the new year The lettering will begin afresh each year planets discovered in the first half of January will be denoted by AA, AB, AC . . ; in the second half BA, BB, BC . . , in first half February CA, CB, CC , the first letter changing twice a month The system permits the insertion of planets afterwards detected on plates The year must be prefixed to the letters, but in practice the last two digits of the year will suffice This system will put an end to the present diversity, three independent systems having been in vogue since the War.

STELLAR SPECTROPHOTOMETRY —*Bull Astron* tome iv fasc iii contains an interesting research by M Jules Baillaud on the distribution of energy in the spectra of stars of types A and B, also of Procyon (type F5) The observations were made at the observatory on the summit of the Pic du Midi (altitude 9384 feet) The curve for Procyon had a maximum at λ425, and resembled that of a black body at a temperature of 7000° The curves for types A, B do not resemble those of a black body at any temperature They fall off much more rapidly from their maximum For type A this occurs in the neighbourhood of λ400, for type B it is at a wave-length even shorter than λ330, which is the limit to which the spectra were studied The descent from this point is even more rapid than that indicated by Planck's formula for temperature 100,000° The author concludes that the spectrum of stars of type B arises from the radiation of ionised atoms He compares the continuous spectrum given by metallic vapours in an arc in vacuo, as observed by M St Procopiu

α Cygni, though of type A, resembles β Orionis closely for the longer wave-lengths but not in the ultra-violet

Two of the stars included here, γ Cassiopeiæ and α Cygni, were also studied by Plaskett Baillaud's curve is much higher in the ultra-violet, perhaps owing to diminished atmospheric absorption He determined the correction for this by observing the same star at different altitudes

Research Items.

THE MOCK KING AT THE NEW YEAR IN EGYPT.—The December issue of *Ancient Egypt* has as a frontispiece a reproduction of the only illustration extant, fortunately preserved by Rifaud, showing the figure of the mock king degraded as *Abu Nerus*. The only account of this curious survival is given by Dr. Klunzinger in his book, "Upper Egypt: its People and its Products," published in 1878. On the tenth day of September, the first day of the Coptic solar year, each little town chooses from among its own members a king whose rule lasts through a festival of three days. During this period all official rule is abrogated and rigorous criminal investigations are held by the mock ruler, in which heavy penalties are inflicted even on the highest officials, and immense taxes are imposed. Both penalties and taxation are remitted for bakhshish. At the end of the three days the mock king is condemned to death and he (i.e. his clothes) is executed by burning. The illustration shows that this festival took place at the date harvest. Sir Flinders Petrie, in a note on the illustration and Klunzinger's account, refers to a title of the XIIth Dynasty, "New Year King of all the Nobles," which was borne by the highest nobles, and points out that this office, which the form of the title shows to have been annual, would indicate that the New Year King was a survival of an age much earlier than dynastic rule. It was a relic of an earlier kingship of prehistoric times and allowed a semblance of the ancient rule to the nobles of the old race, just as the king of the Saturnalia at Rome preserved among the enslaved aborigines a memory of their former liberty.

NEW CORBICULÆ FROM URUGUAY.—The genus Corbicula has a special interest for the student of post-Tertiary geology inasmuch as though now a southern form, it originally in both hemispheres ranged farther north, inhabiting Britain and Siberia in one, and attaining to Nebraska in the other. The American forms differ from the European in that the former have a slight palial sinus, which is wanting in the latter, and have been placed in a separate subgenus, Neocorbicula, by Fischer. Dall, however, has sought to revive Férussac's name of Cyanocyclas, which was only a synonym for Corbicula. Mr. W. B. Marshall in this respect has followed Dall when describing an interesting series of Corbiculæ from Uruguay (Proc. U.S. Nat. Mus., vol. lxvi. art. 15). Altogether eight new species are described and well illustrated, whilst a most useful list of the seventeen previously described American species, with the original references, is appended.

CINCHONA AND IPECACUANHA IN BURMA.—The Report of the Botanical Survey for India for 1923–24 contains further information as to the progress of the interesting experiment upon the planting of an experimental area (now at Mergui) in Burma with cinchona (see NATURE, April 21, 1923, p. 547, and January 5, 1924, p. 25). The conclusion of a brief description of progress is apparently "to confirm the optimism expressed earlier." With the more equable rainfall of Mergui, it appears that the period of nursery culture may be materially shortened, plants set out as quite small seedlings making such vigorous growth after rainfall that they have formed an area of young Cinchona already ahead of the older plants at the former station at Tavoy, now abandoned in favour of Mergui. So far the species to which this report refers is only *C. Ledgeriana*, but *C. succirubra* is also upon trial. Ipecacuanha is also under cultivation at Mergui, "where it is obviously much more at home than it ever can be in the Bengal plantations." Until now, however, no cropping has been attempted, but the policy of multiplication of stock continued.

BARK SCORCH OF WILLOWS.—A bark scorch of willows, caused by the fungus *Fusicladium saliciperdum* Tub., has been known as a troublesome disease of willow rods for some time on the Continent. The disease was noted on the rods of willows grown for cutting in a market garden in Lanarkshire, and specimens were sent to the Edinburgh Botanic Garden for diagnosis, where they were examined by Mrs. N. L. Alcock (Transactions of the Royal Scottish Arboricultural Society, vol. xxxviii. part ii. October 1924, p. 128). The disease first appears as patches on the leaves resembling those of "scab" *Fusicladium dendriticum*, Fuckel, on apple leaves. The disease causes later on striking black patches on the bark giving the rod a piebald appearance, and it may also cause a die-back, and the young rod then turns black from the tip downwards. Little is known as to control, but probably a winter wash of copper sulphate would be useful. Care should be taken when cutting out the rods to cut down to the stock, and not to leave long stubs. Affected rods should be cut out and burnt.

PALÆOZOIC ALGÆ.—Interesting plants from the Old Red Sandstone of Scotland, showing clear indications of algal organisation, are described by the late Dr. R. Kidston and Prof. W. H. Lang in the Transactions of the Royal Society of Edinburgh, vol. 53, part iii. (No. 29), pp. 603-614. *Cryptoxylon Forfarense* Kidston, described in 1897, is rediscussed in the light of a wider knowledge of Nematophyton, and as a result it is transferred to the genus as *N. Forfarense* Kidston, the pseudo-cellular structure of this species being no longer a bar to its transference to this genus. Two new species of Pachytheca are described, *P. media* and *P. fasciculata*. The genus includes a number of spherical forms about half a centimetre in diameter, which when split across show a central region or medulla surrounded by a radially striated cortex, composed of more or less evident tubes. In the newly described species, algal filaments can be clearly discerned on microscopic examination of favourable specimens; these run irregularly in the medullary region, and in groups of seven or more fine filaments through the cortical tubes, emerging from the ends of the tubes in a pencil-like group, in what is described as a peripheral "narrow clear zone." The authors suggest that where the algal organisation cannot be clearly made out, specific names should not be attached to specimens of this fossil, which are widely distributed and relatively abundant in certain formations in Britain. They conclude that the relatively frequent association of Nematophyton with Pachytheca raises interesting problems as to the condition of life of these contemporaneous organisms, and that the mode of occurrence of both of them and the nature of the beds in which they occur will repay further work and co-operation on the part of palæobotanists and geologists.

SUNSPOTS AND TEMPERATURES.—In a recent pamphlet under the title "Sunspots and Temperature, 1916," Mr. A. H. Wallis, of Kimberley, criticises the conclusion of Nordman and Koppen that there is a tendency in the tropics towards low temperatures at times of numerous sunspots, on the ground that the relationship is not invariably valid and is based on the discussion of smoothed means. He suggests for further investigation a law that sudden rises in the daily sunspot number are frequently associated with

rises of maximum temperature He apparently has not had access to the variation curves for 25 regions of the earth's surface from 1820 to 1910 prepared by J Mielke, or to the 97 correlation coefficients worked out by G T Walker, or he would realise that with a coefficient of only -0 2 or -0 3 in the tropics between the annual temperature and sunspot number, a perfect correspondence cannot be expected Also a negative coefficient in annual means might be perfectly consistent with a positive coefficient over short periods such as a day When, therefore, Mr Wallis claims to find in the course of a single year 199 daily agreements of sign in the departures of spots and maximum temperatures and 155 disagreements, he does not upset existing beliefs, neither does he provide much support for belief in a parallel relationship by an agreement of only 56 2 per cent of cases—his 79 4 per cent appears to be in error Also during the year in question, his tables appear to contain 27 occasions on which there was an increase of 24 or more between the sunspot number of one day and the next, and in only 16 of these was there a contemporary rise of temperature All attempts to throw light on this interesting subject are welcome, but a further examination must be made before an addition to our knowledge can be claimed

INVESTIGATIONS OF ATMOSPHERICS —All the various irregular noises which are heard in radiophones are classed together as "atmospherics" In long-distance working they are specially objectionable As a large amount of research work, the results of which are not readily obtainable, has been done on the subject, the paper by Dr R L Smith-Rose published in the January number of *World Power* will prove useful to many The connexion between these noises and neighbouring thunderstorms was discovered at the end of last century by means of a coherer, and use was made of it in France, the owners of vineyards being warned of the approach of thunderstorms During the War the forecasting of thunderstorms was of great value in aviation It has been shown recently that all important atmospherics have their origin in mountainous regions and are due to electrical discharges. The range of a disturbance caused by a lightning flash is usually world wide, and there are always sufficient lightning flashes occurring in some part or other of the world to account for all the noises heard in a radiophone The energy radiated is only a small fraction of the energy required for the local disturbance, and hence radio experts find it difficult to imagine that anything except a lightning flash could produce the observed effects They also think that the disturbances travelling through the ether must have a high frequency The methods used to eliminate these disturbances are to utilise the phenomena of directional reception, the beneficial effects being apparently more pronounced the shorter the wave-lengths used by the station

THEODOLITE OBSERVATIONS WITHOUT FIELD ILLUMINATION —Difficulties are often experienced, especially by workers in remote regions, in obtaining suitable illumination of the field when observing stars with the theodolite An ingenious attachment, which permits of observations being taken without any field illumination, is described by Mr E A. Reeves in the *Geographical Journal* for December last A small semi-reflecting glass disc is placed in the focal plane of the telescope objective, taking the place of the ordinary diaphragm Another similar reflector, which is capable of horizontal and vertical adjustment, is screwed over the eye-lens of the eyepiece When an image of the star is formed on the semi-silvered face of the diaphragm, the transmitted light passes through the eyepiece and emerges as a parallel beam on the eye-lens reflector Part of this beam is reflected backward on to the diaphragm and again reflected into the eye Two images of the star are thus visible These coincide only when the star is in the centre of the field If the star is in any other position, the images part and move in opposite directions, the distance apart being double the error of pointing The device can be readily fitted to, and conveniently used with, any theodolite if the object-glass is reasonably large With a 5-in theodolite, having a 1¼ in aperture, coincidences can be made with 1st and 2nd magnitude and even smaller stars The device should be of use also in mines and other underground works where lamps have to be used as marks upon which to sight the theodolite

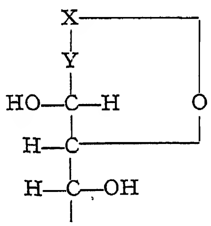
PHYSICAL PROPERTIES OF SINGLE METALLIC CRYSTALS —Dr P. W Bridgman describes some physical properties of single crystals of zinc, cadmium, bismuth, antimony, tellurium, tin and tungsten in the Proceedings of the U S National Academy of Sciences for October 15, 1924 The properties listed include the elastic constants (which vary greatly with direction), linear compressibilities, linear thermal expansions, and electrical resistance The compressibility of cadmium could not be obtained, owing to the existence of two new polymorphic forms under pressure, the transitions taking place at about 3000 and 6000 kg /cm ^{2} (20° C.) The electrical resistance also changes slightly at the transition The properties of the new modifications are very similar to those of the ordinary modification Tellurium exhibits negative thermal expansion along the crystal axis The influence of pressure on the electrical resistance of antimony is anomalous, it tends to indicate that resistance is determined by something more specific than the distance apart of the atoms

HARMONIC TIDAL CONSTANTS —In a paper entitled "Perturbations of Harmonic Tidal Constants" (Proc Roy Soc, A, 106, pp 513-526), Dr A T. Doodson, secretary of the Liverpool Tidal Institute, discusses some unusual features in the results of harmonic analysis of tidal observations at St. John (New Brunswick) and at Bombay The principal lunar semidiurnal constituent M_2 at both stations shows three definite perturbations, one of these is of 19-year period, and arises from a failure of the ordinary method of allowing for the 19-yearly variation of M_2 (due to the varying longitude of the moon's node) The ordinary method assumes that two terms of closely similar period in the tide-generating potential will produce terms in M_2 of proportionate magnitude, and affected by the same phase lag In actual fact this proves not to be the case, particularly at St John, and the author states that, though the magnitude of the effect makes the explanation very difficult to believe, resonance is at present the only assignable cause St John is of course one of the stations where such a phenomenon is least improbable, since the very large tides in the Bay of Fundy are certainly due to resonance with a "sea seiche." But in addition there is another 19-year term in M_2 which can only be explained as due to frictional forces of considerable magnitude, depending on some higher power than the first (probably the second power) of the speed This conclusion depends only on the forms of the expressions for the tidal elevations, and, while it is in general agreement with Dr. H. Jeffreys' calculation of frictional losses in the Bay of Fundy, it involves no numerical assumption as to the friction coefficient Another perturbation of M_2 at St John and at Bombay is a secular change of amplitude, ascribed to possible changes in the sand- and mud-banks near the ports.

Carbohydrate Metabolism.

THE breakdown of the carbohydrates found in the body, namely, glycogen and glucose, resulting in their final oxidation into carbon dioxide and water and the liberation of the energy stored in their molecules, takes place by stages, the details of which are still imperfectly known It appears probable that a compound of glucose with phosphoric acid forms an intermediate stage in the conversion of glycogen into glucose, while lactic and pyruvic acids are intermediate products in the conversion of the glucose into carbon dioxide In the case of striped muscle, the process, as far as the formation of lactic acid, is reversible (Emden, Meyerhof, etc) Now although the monosaccharides formed in the course of digestion are absorbed and converted into glycogen in the liver, in the reverse process only glucose is produced, suggesting that this sugar has some peculiarity of structure which enables the cells of the body to utilise it, in preference to the others enzymes are probably concerned in the process, and one of the characteristics of their action is their specificity

Fresh light has been thrown on this subject by the work of Herring, Irvine and Macleod (*Biochem. Jour*, 1924, vol 18, p 1023), who have used insulin as a key to the structure which the sugar must possess if it is to be utilised The insulin was injected into mice, and the efficiency of various sugars and other closely related substances in curing the convulsions thus produced determined Glucose and mannose cured the animals completely, but fructose and galactose produced only a temporary improvement Maltose, however, was nearly as efficient as glucose, but somewhat slower in its action None of the other substances tried, including substituted reducing sugars and glucosidic compounds, had any effect Analysis of the results shows that the sugar must possess the following formula,



in which X or Y represents the reducing group The cells of the body are, therefore, only fitted to deal with a sugar of this general type, all other carbohydrates being converted into it by their appropriate enzymes, either directly or after synthesis into glycogen

Working on quite different lines, Kay and Robison and their co-workers have investigated the properties and functions of the compounds of glucose with phosphoric acid (*Biochem Jour*, 1924, vol 18, pp 1133, 1139, 1152, 1161) Two of these compounds are described, a hexosemonophosphate and a hexosediphosphate, the phosphoric acid being combined with a different group of the sugar in each case. Both compounds are probably present in the blood An investigation of the distribution in the body of the ferments which act upon them shows that the diphosphate is hydrolysed by an enzyme present chiefly in muscle and blood, while the monophosphate is acted on by an enzyme which can be extracted from bone and ossifying cartilage In fact, it is suggested that the latter compound is the form in which phosphorus is supplied to the bone in ossification The injection of insulin increases the amount of the organic phosphoric esters in the blood and muscles, and it is extremely probable that it is the hexosephosphates which are thus affected In this case the fall in the blood sugar after insulin may be connected with the formation of these esters, since it appears that the sugar disappearing is not all oxidised, nor is it converted into fat (*v* Burn and Dale, *Jour Physiol*, 1924, vol 59, p. 164). The formation of a phosphoric ester would, however, be probably only a step in the reversible reaction, glycogen $\rightleftarrows$ glucose The actual direction in which the reaction proceeds depends in all probability on the amount of glycogen in the body in the well-fed animal, the glycogen present is broken down, in the diabetic organism, the reverse process occurs and glycogen appears in the liver

The phosphorus for the synthesis of the ester comes in the first place from the inorganic phosphate of the blood, with the result that less is left available for excretion by the kidney in the urine Sokhey and Allan (*Biochem Jour*, 1924, vol 18, p 1170), confirming other investigators, have found that dogs after large doses of insulin excrete less inorganic phosphate in the urine during a period of six hours or so the total output for the day is, however, definitely increased, suggesting that some of the newly formed esters are broken down later on The nitrogen excretion is raised simultaneously with the fall in inorganic phosphate possibly some of the phosphorus required comes from organic compounds which also contain nitrogen Sugar *per os*, on the other hand, while diminishing the inorganic phosphorus of the blood and urine temporarily, does not cause any increased total output of this element in the 24 hours at the same time it lowers the nitrogen excretion by taking the place of some of the protein previously oxidised It appears then that, with excess of sugar in the blood, more of the esters are formed at the expense of the inorganic phosphorus, but that, although the subsequent oxidation is sufficient to reduce the nitrogen excretion by sparing the destruction of protein, it is not enough to raise appreciably the excretion of phosphorus in the urine, the sugar is probably oxidised directly without previous synthesis to glycogen Insulin, however, causes a great increase in the formation of the esters, the phosphorus coming both from inorganic phosphates and also from bodies which contain nitrogen as well as phosphorus in their molecules The glucose necessary is obtained from that circulating in the body fluids, but in the normal animal an additional source is provided by the reserve glycogen of the liver and muscles, the breakdown of the latter would produce an excess of free phosphorus, which would appear in the urine

A somewhat different reaction is to be expected from feeding sugar and injecting insulin glucose alone will not raise the total metabolism to any appreciable extent, while insulin, under certain conditions, will do so by increasing the carbohydrate oxidised, without at the same time reducing the protein broken down: in the normal animal, a limit is probably set to the amount of carbohydrate catabolised at any moment by the amount of insulin available It seems justifiable to draw the general conclusion that insulin acts by assisting the reversible reaction glycogen $\rightleftarrows$ phosphoric ester $\rightleftarrows$ glucose, by causing the production of the ester, the direction in which the reaction proceeds thereafter depends on the amounts of the various interacting substances present at the moment.

Nature and Origin of Coco-Nut Pearls.[1]

By Dr F W T HUNGER

IN the endosperm cavity of the seed of *Cocos nucifera* a local calcareous formation is sometimes found to occur, to which the name of "cocos-pearl" has been given, and which must be looked upon as a highly remarkable and very rare occurrence.[2] Such a cocos-pearl has usually the form of a pear, or egg; sometimes it is almost spherical and has a smooth surface, as a rule of a milky-white colour. Its chemical composition corresponds somewhat to that of the oyster-pearl, from which it differs in appearance, however, by the lack of the pearly sheen.

Rumphius was the first to describe this calcareous formation as "calappites,"[3] and for more than a century after him nothing was heard of this condition, until at the meeting of the Boston Society of Natural History on February 1, 1860,[4] Mr Fred T Bush presented a specimen of this cocos-pearl for chemical and microscopical examination. The research was entrusted to Dr Bacon, who submitted his report on the subject at the meeting of the same Society on May 16, 1860.[5]

In 1866, Dr. Riedel, ex-Resident of Menado, reported having found a pearl in a coco-nut he opened.[6] This was the first report by an eye-witness who had actually seen such a thing, apart from the many stories told by natives about it.

Contrary to the statement of Bush to the effect that cocos-pearls "are said to be found free within the cavity of the coco-nut," Skeat[7] reported in 1900 that they are "usually, if not always, found in the open eye or orifice at the base of the cocoa-nut."

On my last voyage to the East Indies for purposes of study, I resolved to endeavour to find out something further about the cocos-pearl and if possible solve the problem of its formation. At the same time I realised the utter futility of going to look for cocos-pearls in the tropics, on account of their extremely rare occurrence. In proof of this it may be mentioned that on a coco-nut estate, where approximately three million nuts have been opened annually for years, no such pearl has ever been found, although stories about them have led to their existence being suspected.

I therefore directed my research to gathering as many authentic data as possible. On one of my voyages I met a native of British India who possessed a very fine cocos-pearl. According to his own account, he had seen with his own eyes this specimen inside an opened coco-nut which had been brought to him from Madras. He assured me that his pearl had been attached to the kernel of the coco-nut and exactly at the place where, in germination, the cotyledon forms a haustorium.

Later on I also met with an Arab on whose coco-nut plantation in South Borneo a coco-nut had been gathered which, on being opened, proved to contain a pearl attached to the inside of it. He had dislodged the pearl from the kernel of the nut with his own hand. In this case also the pearl had been attached at exactly the same place as in the case first mentioned.

These two corroborative declarations of eye-witnesses, who had both seen a cocos-pearl still attached inside an opened coco-nut, furnished me with a preliminary guiding-thread and led me to suppose that the spot which they indicated would probably be the normal point of attachment of such a cocos-pearl.

The normal germination process of the coco-nut begins by an enlargement of the embryo, whereby the cotyledon commences to grow inwards to an absorbing organ (haustorium), and thereby comes to protrude outside the endosperm and into the central cavity. Simultaneously with this, the plumule grows out and, breaking through the membranous operculum of the germinating pore, it pushes its way out through the hard shell.

Proceeding from the provisional determination of the place of attachment of the cocos-pearl, the following hypothesis could now be formed. Given that the germination, being in progress, is stopped by some cause or other, thus preventing the further development of the haustorium, it is conceivable that the haustorium in this state might become encrusted by the influence of the coco-nut milk, and that from this the completely petrified cocos-pearl would gradually be formed.

It was now necessary to find the reason for any such check in the process of germination and the accompanying solidification of the haustorium.

At the side where the coco-nut has been attached to the stalk, three thin spots, so-called germinating pores, or "eyes," can be seen in the hard inner shell of the fruit. As a rule one of these holes, the so-called "porus pervius," is closed by a membrane, whereas the two other, the so-called "pori cæci," are furnished with a hard tegument. In germination, the plumule pushes its way out through the porus pervius.

By way of exception there may be, instead of three, two germinating pores, namely, one porus pervius and one porus cæcus, and only very rarely will there be only a porus pervius with both pori cæci entirely absent. Nevertheless, a coco-nut of this description can germinate in the usual way. It is a different case, however, when there is not even a porus pervius, the base of the inner shell showing no germinating pore at all, as occurs in extremely rare cases. Such a coco-nut is known in the Malay language as a "kĕlapa boeta," or "klåpå boentĕt" in Javanese, which signifies a "blind coco-nut."

As remarked above, a coco-nut without germinating pores is a very great rarity, for which reason they are regarded by the Mohammedans as sacred. The "kĕlapa boeta" is a talisman (*tjimat*) *par excellence*, and consequently it is difficult to obtain a specimen.

This meeting with the *kĕlapa boeta* furnished me with an example of the way in which normal germination is rendered impossible in Nature, and I did my utmost to procure some specimens. I finally succeeded in collecting eight unopened "blind" coco-nuts from the East Indian Archipelago. Most of the specimens were very old nuts; some, according to their owners, had been preserved for scores of years as family heirlooms.

The first four "boetas" which I opened produced nothing, but in the fifth I found a really beautiful pearl still attached to the kernel; the next two produced negative results again, and the eighth specimen I have kept unopened.

The nut which had contained the pearl had been gathered but a short time before, and the endosperm in it was quite normal, whereas in the other nuts the kernel was either very much dried up or had even partly become a mass of brown powder. The

[1] Reprinted, by kind permission of the author, from the Proceedings of the Koninklijke Akademie van Wetenschappen te Amsterdam, vol xxvi Nos 5 and 6

[2] F W T Hunger, "Cocos nucifera," 2nd ed pp 243-250, Pl lxvii (1920)

[3] E Rumphius, "Herbarium Amboinense," vol. i pp 21-23 (1741), "D'Amboinsche Rariteitkamer," pp 291-292 (1741)

[4] Proceedings of the Boston Soc of Nat Hist, vol vii p 229 (1861)

[5] *Ibid*, vol vii pp 290-293 (1861)

[6] NATURE, vol 36, p 157 (June 16, 1887)

[7] W W Skeat, "Malay Magic, being an Introduction to the Folk-lore and Popular Religion on the Malay Peninsula," p 196 (1900).

pearl was attached without the least trace of a stalk, being merely embedded in the endosperm, and was quite easy to remove from the kernel It lay exactly at the base of the nut, just under the spot where the germinating pores ought to have been, and thus agreed completely with the indications as given above

This discovery, in my opinion, warrants the inference that the cocos-pearl actually represents a calcified haustorium, which has been retained in the nut after the primary germination was checked, owing to the plumule not being able to get through the shell on account of the absence of the porus pervius As the inner shell of the *kĕlapa boeta* remains hermetically closed, the newly formed haustorium becomes encrusted under the influence of the coco-nut milk with calcium salts, although it still remains unexplained why the cocos-pearl consists almost entirely of calcium carbonate, while neither the cocos-kernel nor the coco-nut milk contains this carbonate

The belief that a *kĕlapa boeta* invariably contains a cocos-pearl was sufficiently disproved by my experience, that of seven specimens, only *one* such formation was found in a "blind" coco-nut On the other hand, it is probable, in my opinion, that it will be principally (or exclusively ?) the *kĕlapa boeta* that contains the cocos-pearl

Annual Meeting of the Mathematical Association.

THE annual meeting of the Mathematical Association was held at the London Day Training College on January 5 and 6 The report of the Council showed that the number of members has increased to 1019, in addition to about 500 associates connected with local branches

The presidential address was delivered by Prof G H Hardy, the subject being "What is Geometry ?" Prof Hardy suggested that the time has come to consider what the subject taught in schools under the name of geometry really comprises It appears to be a mixture, partly an investigation of actual space-relations, based on intuition, partly a system of pure geometry, based on axioms But neither of these subjects is self-contained Even the so-called projective geometry is not true projective geometry but is based on ideas of geometrical magnitude While recognising that the early teaching of geometry must be a compromise, and that the Association has done very good work in improving it, he thought that an effort might now be made to introduce into schools a more logical study of modern systems of pure geometry

Prof H Levy gave an address on "The Mathematical Laboratory, its Scope and Function" He said that mathematics is not merely the handmaid of science Mathematical methods based on logical proof are not sufficient for modern needs the methods must be developed so as to meet the requirements of technology—of aeronautics, of biology, of industry He gave an account of the work done at the mathematical laboratory of the Imperial College of Science and Technology, S Kensington The work, fundamentally, is experimental Any instruments available may be used, and the traditional restriction to rule and compasses is abolished Absolute accuracy is not regarded as essential, and graphical methods, giving results within about 0 5 per cent, are found to be sufficient The problems to be solved are engineers' problems, not the mathematician's conception of engineers' problems Differential equations are solved by approximation, by differentiation, etc, and their mathematical treatment in the lecture-room is followed by graphical treatment in the laboratory The calculation of infinite series, and their differentiation, gives ideas of convergence and divergence of series, and a good deal that is of value can be derived from cases in which series obtained by graphical methods give incorrect numerical results in consequence of the series being divergent Importance is attached to the study of cases in which different problems lead to the same mathematical equation In the discussion on the paper, it was suggested that in a school the cost of equipment of a mathematical laboratory might be prohibitive, but Prof Levy pointed out that, as great accuracy is not essential, second-hand instruments are usually quite good enough

A discussion on the teaching of arithmetic in schools was opened by Prof J E A Steggall, who suggested that more attention might be given to the study of the properties of numbers, and that, in the earlier stages, children might concentrate on the study of some particular table, such as the table of measures of length The discussion raised some interesting points as to method, and questions as to the psychology of the pupil Prof Steggall, in replying, expressed his disapproval of the teaching of anything that could not be understood

There was some discussion of the recent report (of the Association) on "The Teaching of Geometry in Schools" Prof M J M Hill dealt with various methods of arriving at the properties of parallel lines

Mr A Buxton communicated a note on the treatment of a certain problem in optics by means of Bessel functions

Dr H B Heywood contributed a thoughtful paper on the reform of university mathematics In foreign universities, courses are given in subjects of which students in Great Britain have practically no knowledge The whole of our mathematical teaching in universities, even more than in schools, is dominated by examination requirements, and no reform is possible until the examination system is modified Some suggestions that Dr Heywood made were that it is not necessary to examine over the whole field, but that an intensive study of some part should be allowed, that theses, followed by oral examination, should be encouraged, that more importance should be attached to reports by teachers, and that over the whole range the study should be less academic There is no border-line between mathematics and physics, and there is no need for physics to be made fictitious when it becomes a subject for mathematical treatment The extent of ground common to mathematics and physics should be investigated The decision as to the content of a mathematical course must be made on the basis of vitality, and this requires a purposeful study of the whole domain of mathematics, to see what portions are alive and growing Such a study would show what reforms are needed In the discussion, Prof E W Hobson agreed that reform must work downwards from the universities, but he was inclined to dissent, at any rate as regards Cambridge, from the view that the universities are more dominated than the schools by examination requirements Prof Hardy stated that he considered reform to be impossible without destruction, and said he would like to begin by destroying the mathematical tripos

During the luncheon interval, on the second day, there was a very interesting exhibition of pieces of apparatus, designed by Mr E J Atkinson, by Mr. C V Durell, and by Mr D F Ferguson, for use in connexion with the teaching of mechanics.

University and Educational Intelligence.

CAMBRIDGE —The Sedgwick Prize has been awarded to Mr. H Hamshaw Thomas, fellow of Downing College

Mr C. T. R. Wilson, fellow of Sidney Sussex College, university reader in electrical meteorology, and observer in meteorological physics at the Solar Physics Observatory, has been elected to the Jacksonian professorship of natural philosophy

OXFORD —It is expected that in the course of the present term, which began on January 19, much progress will be made with the final settlement of College Statutes, which are now before the Universities Commission

The Romanes Lecture for 1925 will be delivered by Sir William Bragg in the Sheldonian Theatre on Wednesday, May 20, at 5 30 P M Sir William's lecture will be on " The Crystalline State "

PROF ANDREAS VON ANTROPOFF, of the Technische Hochschule, Karlsruhe, has been offered the chair of physical chemistry at the Chemical Institute in the University of Bonn

ACCORDING to a message from the Toronto correspondent of the *Times*, the will of the late Mr D A Dunlap includes bequests of 50,000*l* to Victoria University, one of the constituent colleges of the University of Toronto, and 20,000*l*. to the University of Toronto for medical resources

MR F J. HARLOW has been appointed principal of the Wigan and District Mining and Technical College, in succession to Mr S C Laws, who has become principal of the Northampton Polytechnic Institute, London Mr Harlow has been, for the past four years, principal of the Blackburn Municipal Technical College He is a B Sc. (Physics, 1st class honours) of the University of London and an associate of the Royal College of Science, and he also holds the diploma (by research) of the Imperial College of Science and Technology

PROF H E ARMSTRONG, addressing the students of the Stoke-on-Trent evening schools on January 8, protested vigorously against the unpractical character of the teaching in English schools. " School, in the main, is but the means of keeping children occupied and ignorant up to a certain age there is no conscious logical method behind it " Hence it is that our commercial men and leaders of industry are ill-informed, and manual dexterity is going from us owing to our slavish use of machinery To prate of the value of the study of the humanities while we welter in ignorance of the world about us, and the public remains incapable of appreciating and using the vast achievement of scientific workers for its intellectual development, Prof Armstrong stigmatised as " pure Pecksniffery " If the Potteries are to be capable of meeting the coming competition of Germany, the type of teacher required is the enthusiast for " Beauty in its many forms, one of which, and the greatest, is Truth," with power to kindle the imagination of pupils and other teachers Thence will come capacity for producing work of beauty and value which will therefore attract The number of students enrolled for the current session in the Stoke-on-Trent evening schools reaches the respectable total of 5700, including more than a thousand in the Art Schools and 600 in the Central School of Science and Technology, which, by the way, is extending its pottery course, for students who have completed a secondary school curriculum, from three to four years. It has a separately organised research department, with a staff of eight investigators

Early Science at the Royal Society.

January 25, 1664/5 In order to see, whether the compression of the air caused the extinction of fire, there was put a lamp into the condensing engine, and a great quantity of air being crowded into it, it was found, that the lamp burnt in that compressed air about 15 minutes, whereas in the uncompressed air in the same engine, it burnt not above 3 minutes — It was ordered that at the next meeting an experiment should be made, of filling a vessel with smoke, to see, whether a candle put into it would burn as long therein, as it would do in the same air without smoke.

1671/2 Mr Oldenburg read a letter from Mr Newton from Cambridge, of a way of preparing a fit metalline matter for reflecting concaves "I desire," he says, "that in your next letter you would inform me, for what time the Society continue their weekly meetings, because if they continue them for any time, I am purposing them, to be considered of and examined, an account of a philosophical discovery, which induced me to the making of [my] telescope, and I doubt not but will prove much more grateful than the communication of that instrument, being, in my judgment, the oddest, if not the most considerable detection, which hath hitherto been made in the operations of nature "

January 26, 1670/1. Mr Oldenburg produced some of the rock-salt lately digged up in Cheshire, mentioning that the workmen had bored three yards into it. That an hot fire makes the salt crack and fly like bags of kelp That hot water dissolves it speedily, and cold slowly that being pulverised it is a very strange salt, and the brown, that is free from mixture full as sharp as the white

January 27, 1663/4. Ordered—That the president move this day the Society to appoint a committee of physicians, who are fellows of the Society, constantly to consider, what is necessary to be prosecuted in anatomy and surgery —That the porter be allowed three pounds a year for his constant attendance, to be paid him quarterly

1669/70. Mr Oldenburg read the paper concerning Cassini's pretended new method, geometrical and direct, of finding the apogees and excentricities of the motion of the planets after which he moved, that it might be inquired into, whether the like method had not been already found out in England Whereupon Mr Mercator, having considered this matter in private, produced a paper of his, which shewed, that this very thing was founded upon what Dr. Seth Ward, now lord bishop of Salisbury, had demonstrated in his " Astronomia geometrica " published in 1656. This paper was read, and being found to be the demonstration of this alleged invention of Cassini, printed as such in the French *Journal des Sçavans* of September 2, 1669, it was thought proper, that the narrative of the truth of this matter should be published in the *Philosophical Transactions*.

January 28, 1662/3. Mr Hooke made the experiment of shutting up in an oblong glass a burning lamp and a chick, and the lamp went out within two minutes, the chick remaining alive, and lively enough —Mr Matthew Wren gave an account of a carp kept a whole week in a cellar out of the water, and fed with moistened bread, wetting the gills of it once or twice a day Dr Croune was put in mind to make this experiment, as he had formerly promised

1668/9. The copies of Mons Huygen's theory of motion were delivered, one to Dr Wren, and another to Mr. Colwall

January 30, 1660/1. Being the day of fast and humiliation for the death of King Charles I there was no meeting of the Society.

Societies and Academies.

LONDON

Royal Society, January 15.—Sir Charles **Sherrington** and E. G. T. **Liddell**: Further observations on myotatic reflexes. The myotatic reflex of the knee-extensor obtains after pre-collicular as well as after inter-collicular transection. The reflex retains tonic character after exclusion of the otic labyrinths. Stretch of the knee-flexors also yields a myotatic reflex, a main action of which is the depression by inhibition of the myotatic reflex of their antagonist, the knee-extensor. The reflex relaxation of the knee-extensor thus obtained is not changed into contraction by administration of strychnine.—A. V. **Hill**, C. N. H. **Long**, and H. **Lupton**: Muscular exercise, lactic acid, and the supply and utilisation of oxygen. An attempt is made to apply to the case of muscular exercise in man the principles discovered in the last seventeen years by the physical and chemical investigation of activity in the isolated frog's muscle. Part I. summarises the investigations, especially such as refer to the recovery process by which lactic acid, liberated during exercise, is removed in the presence of oxygen afterwards. In Part II. is described the method of estimating lactic acid in human blood. Part III. is a description of the lactic acid changes which occur in human blood, during and after exercise, with an account of their effect on the respiratory quotient. Part IV. describes methods of studying the respiratory exchanges in man, under the rapidly altering conditions which obtain at the beginning and end of exercise. Part V. is an account of the recovery process, in which oxygen is used and the lactic acid produced during activity is restored as the glycogen from which it arose. In Part VI. a discussion is given of the "oxygen debt" existing at the end of exercise, and of the muscle as an "accumulator of energy." Part VII. describes the relation between the rate of oxygen intake and the intensity of exercise. Considerably increased amounts of oxygen can be taken in when breathing gas mixtures rich in oxygen. In Part VIII. curves are given relating the "oxygen requirement" to the severity of various types of exertion.—A. P. **Chattock**: The physics of incubation. Daily cooling appears to be unnecessary, but an improvement in the hatching of more than 11 per cent. is indicated if the usual twice-a-day turning is increased to four times at equal intervals. By means of specially designed hygrometers, values of the humidity under hens have been obtained; very little improvement resulted from raising the humidity in incubators to the hen's nest value (20 mm. water-vapour pressure at the centre). On the principle that the water vapour and carbon dioxide which escape from the eggs during incubation must both leave the nest by the same paths, the ventilation in a hen's nest may be estimated. The value obtained is equivalent to the passage through the nest of 3.2 cubic feet of air per hour per 50 eggs; and is several times smaller than the ventilating air flow in typical "hot air" and "tank" incubators.—J. F. **Fulton**: (1) The influence of tension upon the electrical responses of muscle to repetitive stimuli. Simultaneous mechanical and electrical records of short, maximal, tetanic responses of intact skeletal muscle (gastrocnemius and sartorius; frog) have shown that the *size* of the successive electrical responses varies in isometric contraction with the tension developed, and in isotonic records with the work done. Tension *per se* rather than length of fibre controls the size of the action current. The mechanism which determines the size of the action current probably also controls the energy liberation within the fibre. (2) The relation between the durations of the isometric twitch and of the after-action of tetanus. The end of the plateau of short tetanic responses is characterised by an "angle" similar to that of the twitch. The duration of the after-action as measured from the beginning of the last electrical response of the tetanus to the "angle" is, in short tetani, invariably less than the duration of the twitch. The ratio of these two durations is approximately the same as that of the size of the corresponding action currents. The terminal "angle" of long tetani is less precise than in short, and is also less precise at high initial tensions than at low tensions. These modifications of the "angle" may be taken as evidence of slight fatigue—a less prompt "neutralisation" of the activating ions. (3) Some observations upon the electrical responses and shape of the isometric twitch of skeletal muscle. Isometric twitches of the intact gastrocnemius of frogs, when recorded with a myograph of high natural frequency, have a flat top which terminates with sufficient abruptness to form on the linear record a clearly defined "angle." Any factor tending to produce fatigue, obscures the "angle." From the shape of the isometric twitch it has been inferred that the "fundamental" process of contraction is rectangular in shape, the "angle" representing the point at which it ends, and the curve of relaxation representing the viscous return of the muscle to its resting shape.

PARIS

Academy of Sciences, December 15.—M. Guillaume Bigourdan in the chair.—P. **Villard**: The construction of electro-magnets. Comparison of results obtained with differently shaped pole pieces, one cylindrical the other conical.—Ch. **Depéret**: The classification of the older Palæolithic from the historical and geological points of view. The palæolithic strata known as the Chellean consists of deposits of two different ages. One of these is older than the Chelles gravels, and for this the term pre-Chellean is proposed. The difference of age is shown both by the fauna and by the worked implements.—Ch. **Depéret**, Fabien **Arcelin**, and Lucien **Mayet**: New discoveries in the prehistoric deposit of Solutré (Saône-et-Loire). Following up the discoveries of human remains made in 1923, excavations near the same spot have revealed two more complete skeletons of Cro-Magnon type. The excavations of 1924 at Solutré have proved the existence, in regular superposition, of a series of levels containing graves, ranging from the Aurignacian epoch up to historic times.—Maurice **Lugeon**: River erosion. Example of the Rio Uruguay.—C. **Sauvageau**: The curious development of *Castagnea Zosteræ*.—Paul **Montel**: Some special complex families.—J. **Haag**: The combination of the results of observation.—René **Thiry**: Parallel displacement in Weyl's geometry.—B. **Galerkin**: The stability of a plate uniformly compressed parallel to its surface, limited by two arcs of concentric circles and by two radii.—P. **Laffitte**: The propagation of the explosive wave. C. Campbell has shown that if the diameter of the tube containing an explosive gas mixture increases suddenly, the explosive wave ceases to propagate itself, starting from the point of discontinuity. Experiments described by the author made with two gas mixtures ($CS_2 + 3O_2$ and $2H_2 + O_2$) show that although the explosive wave ceases to be propagated, starting from the point where the diameter changes suddenly, it reforms in the second tube after a period of combustion.—Léon and Eugène **Bloch**: The spark spectrum of iron in the Schumann region. The wave-lengths and intensities of 253 lines in the

region 1855 Å and 1505 Å are given about half of these are new.—Alb **Colson**. The displacement of the maximum of solubility and the existence of constant solubilities.—E **Carrière** and E **Vilon** Experimental study of the action of sulphuric acid on calcium oxalate After proof of the existence of an equilibrium, the influence of each of the variables, temperature, concentration of calcium oxalate and sulphuric acid, and excess of sulphuric acid was separately determined, the results being shown in the form of curves.—Claude **Fromageot** Adsorption and cataphoresis.—P **Lebeau** and P **Marmasse** The thermal fractionation of the gaseous products from the carbonisation of the structural constituents of bituminous coals Fusain, durain, clairain, and vitrain from an English coal, and vitrain and durain from a French coal have been submitted to the method of fractional carbonisation described in an earlier paper (*Comptes rendus*, 177, p 319) The results are shown graphically and analyses of the total gas obtained given The composition of the gases obtained are very similar and they do not differ much from the gas obtained by the carbonisation of the original coal The two vitrains, however, show a higher percentage of methane.—G **Saurat** The quaternary formation of Syrte minor.—Pierre **Lamare** The presence of granites in the valleys of Baztan and Bertizarana (Haute-Bidassoa) and their tectonic significance.—G **Mouret** The geology of the Plateau of Aigurande and the dislocations of the neighbourhood of Neris (Allier).—Sabba **Stefanescu** The presence of *Elephas planifrons* and of three mutations of *Elephas antiquus* in the geological layers of Roumania.—H **Hérissey** The presence of a glucoside in *Baillonia spicata* capable of being hydrolysed by emulsin, and the products of hydrolysis of this glucoside The glucoside was not isolated, but from its hydrolysis by emulsin, *d*-glucose and a lactone, named baillonigenol, were isolated in a pure and crystallised condition.—P **Freundler** The conditions of the stabilisation of iodine in *L flexicaulis* The initial amount of iodine in these algæ may be preserved in three ways increasing the saline concentration, heating in closed vessels at 110° C, or by complete desiccation at 105° C.—L **Grigoraki** Contribution to the study of Dermatophytes.—A **Maige** The evolution of amylogen excitability of the plastids in cells with starch reserves.—Maurice **Nicloux** and A **Yovanovitch** The fixation of chloroform by the central nervous system and the peripheral nerves The method previously worked out for the determination of minute quantities (0·5 mgm to 1 mgm) of chloroform in blood and the tissues has been applied to the study of the amounts of chloroform fixed by the nerves after anæsthesia The peripheral nerves, such as the central nervous system, fix the largest quantities of chloroform.—R **Herpin** The swarming and development of Eunice and Syllis.—Armand **Dehorne** The histo-physiology of the intestinal cells of Ascaris of the horse and of the turtle.—Ch **Pérard** Researches on the destruction of the oocysts of Coccidia The oocysts of *E perforans* and *E stiedæ* have been submitted to the actions of solution of various disinfectants, including formol, phenol, corrosive sublimate, and hypochlorites, and are not destroyed after 24 hours' exposure to these media, and in fact appear to develop better after such treatment On the other hand, these organisms are very sensitive to drying or to heat and this is recommended for their destruction.—Henri **Stassano**. The mode of action of heat on the lactic ferments in the pasteurisation of milk Three methods were tested maintenance at 95° C for two minutes, at 63° C for 25 minutes, and in thin layers at 75° C for 8 seconds Some lactic ferments survive all three methods of pasteurisation, but the third method proved relatively the most efficient.—P **Lemay** and L **Jaloustre** The comparative action of bismuth on staphylococcus, streptococcus, and the Coli bacillus The staphylococcus is most sensitive to the action of bismuth salts.—H **Labbé** and **Lavagna** The action of acetoacetic acid on the nitrogen nutrition.—W **Kopaczewski** Surface tension and the cancer problem It is proved by experiment that the development of cancer is accompanied by a diminution of the surface tension of the serum and blood plasma.—Jean **Saidman** The absorption of ultra-violet rays by the skin and its therapeutical applications.—**Kohn-Abrest** The index of toxicity and the utilisation of petrol in motor-cars The ratio CO/CO_2 in the exhaust gases of a petrol motor is defined as the index of toxicity Some determinations of this index are given, based on analyses of the exhaust gases of a motor-car working under different conditions

CALCUTTA

Asiatic Society of Bengal, December 3.—C **Dover** Further notes on the Indian diplopterous wasps The subject is discussed from the faunistic point of view, and is based on a study of the Vespidæ in the British Museum, it is an attempt to settle the systematic position of various Indian forms.—Satya Churn **Law** Kālidāsa and the migration of birds, No 2 The migratory Hansas and Raj-hansas in Kālidāsa's works.—H **Beveridge** On Tamerlane A review of the information in our possession about "the terrible Vulcan of Samarcand."—Maulavī **'Abdu'l Wali** Notes on the archæological remains in Bengal The antiquities dealt with are situated in Burdwan, Murshidabad, Midnapur, Narayanganj, Birbhum, Aurangabad and other places.—Hirendra Lal Sen **Gupta** A short history of the Madhyamika philosophy.—Harit Krishna **Deb** "Ant-gold" and the Kautilīya Arthasāstra The story of the so-called gold-digging "ants," in the sandy regions of Dardistan, related by Herodotus and later writers, is referred to in a passage in the Kautilīya Cunningham's conjecture that these "ants" were some kind of marmots is confirmed Incidentally, it is suggested that the "griffins" alleged to guard the gold dug up by "ants" may have been some variety of ant-eaters.—Harit Krishna **Deb** (1) The Kautilīya Arthasāstra on the three classes of invaders Invaders are classified in the Kautilīya as *dharma-vijayinah*, *lobha-vijayinah* and *asura-vijayinah* The pre-Asokan date of this classification being shown, the inference is that India was already familiar with the Assyrian (asura) mode of invasion.—(2) The Kautilīya Arthasāstra on forms of government The Kautilīya presents us with a threefold classification of forms of government, here analysed, namely, *rājya*, *dvairājya* and *vairājya*, corresponding respectively to government by one, by two or by the multitude The Kautilīya's discussions contain helpful hints for a reconstruction of pre-Mauryan political and constitutional history.—Chhote Lal **Jain** A bibliography of literature relating to Jainism, mainly from 1907 to 1924.

ROME

Reale Accademia dei Lincei Communications received during the vacation, 1924.—T **Levi-Civita**. Exact determination of periodic irrotational waves in deep water.—E **Carano** Observations on the mechanism of division of the mother-cell of the embryo sac in apogamous plants.—Bonaparte **Colombo**. Study of the equations

$$\frac{\partial^3 z}{\partial x^2 \partial y}+\frac{\partial^3 z}{\partial x \partial y^2}=f(x, y, z, p, q, r, s, t)$$

and

$$\left(\frac{\partial}{dx}+\lambda_n\frac{\partial}{\partial y}\right)\left(\frac{\partial}{\partial x}+\lambda_{n-1}\frac{\partial}{y}\right)$$
$$\left(\frac{\partial}{\partial x}+\lambda_2\frac{\partial}{\partial y}\right)\left(\frac{\partial z}{\partial x}+\lambda_1\frac{\partial z}{y}\right)=F(x, y)$$

—Francesco **Sbrana** Certain integral equations —Washington Del **Regno** Photo-electric emission of selenium No difference is detectable, between the emission from selenium in the dark and in the light, the free electrons thus appearing to play no part in the phenomenon The purely electronic character of the conductivity of selenium under the influence of light is upheld —Bernardo **Oddo** Di-indylmethane —Gaetano **Charrier** and Alessandro **Beretta** Action of nitrosobenzene on *o*-nitroaniline The product of this action is *o*-nitro-*p'*-nitrosodiphenylamine —Gustavo **Cumin** Geological notes on the Istrian mountain region I Soils —Enrico **Fossa-Mancini** Tertiary strata in the neighbourhood of Orosei (Eastern Sardinia) —Ugo **Panichi** . The specific gravity of minerals and crystallised chemical compounds —G **Micatovich** Experiments confirming the statolytic theory —A **Spartà** Contribution to the knowledge of larval development in *Uraleptus Maraldii* Risso —Livia **Garofolini** Development of the chromaffine system and appearance of the chromoreaction in *Triton cristatus* —Luisa **Volterra** Variability of pelagic Dafnias in Lakes Albano and Nemi *Daphnia longispina* —Ugo **Banderati** Action of alcohols on the sensory-motor cortical centres of the dog —Mario **Ercole** Contribution to the knowledge of the rhythm of renal secretion —Carlo **Mannella** Action of strychnine on the survival of the central preparation —Carlo **Petacci** Action of ethyl alcohol on the survival of the central preparation —Palmira **Tavolaro** Direct action of strychnine and various alcohols on the central preparation —Oliviero **Olivo** Commencement of the functional capacity of the contractile tissues in the embryo of the hen, in relation to their structural and morphological differentiation I Functional and morphological differentiation of the cardiac embryo —Gabriella **Armellini-Conti** and Giuseppe **Armellini** Investigations on the variation of the luminous intensity of the moon during the total eclipse of August 14, 1924 From the moment at which the moon entered the earth's shadow until the eclipse became total, the total luminous intensity of the moon varied approximately according to a parabolic law When the moon, entirely in the penumbra, began to enter the umbra, the intensity was nine-tenths of that exhibited by the full moon, whilst the intensity of the totally-eclipsed moon was about one-fortieth of that of the full moon —F **Zambonini** and G **Carobbi** Contribution to the study of the isomorphous relationships between compounds of beryllium and those of magnesium In compounds of simple structure, beryllium and magnesium are probably not isomorphogenic except in very special cases, but mixed crystals of the double nitrate of magnesium and lanthanum with that of beryllium and lanthanum containing so much as 18 per cent of the latter are obtainable —L **Sabbatani** Pharmacological investigations on iron VI Colloidal ferrous sulphide prepared in the presence of sugar A preparation has been obtained which is much less toxic than that made in the presence of gelatin and is fixed more exactly and immediately, and almost exclusively in the liver and spleen. Such preparations produce pharmacological effects only as the result of chemical changes, which are rapid and profound with colloids of high degrees of dispersivity and stability, but slow and slight if the degrees of dispersivity and stability are low —B **Longo** Further results on the sowing of the wild fig —A **Russo** Different constitutions of the two pure gametes in *Cryptochilum echini* Maupas, resulting from the analysis of the nuclear successions, and the prevalence of the globuliform micronucleus —Francesco **Sbrana** Levi-Civita's parallelism for a surface of ordinary space —Umberto **Crudeli** Stationary motions in electronic dynamics —Enrico **Fermi** Theory of collisions between atoms and electric corpuscles —G **Carobbi** Double nitrates of metals of the cerium group with copper and with cadmium —G **Sani** and V **Grilli** Practical notes on the conservation and transformation of nitrogen in stable manure —Angelo **Bianchi** Bismuthinite from Crodo, Val d'Ossola, and the crystallographic constants of bismuthinite —E **Onorato** Celestine from Caramanico —Emanuele **Quercigh** . Celestite from Pietraperzia and from Trabonella (Caltanissetta) —Carmela **Ruiz** Celestite from Racalmuto (Girgenti) —Roberto **Savelli** . Genetic theory on the "electric mutations" obtained by Alberto Piròvano —Cesare **Artom** The species of *Gambusia* acclimatised in Italy (*Gambusia holbrooki* Grd) in relation to the stability of the character of the gonopodium —Giulio **Cotronei** Dimensions reached by *Petromyzon fluviatilis* and the phenomenon of contraction With this animal, the percentages of the two sexes may be considered identical The female is larger than the male, and the form living in Southern Europe attains smaller dimensions than that of the north —Boldrino **Boldrini** Certain biological reactions encountered in the blood serum of women during and after the lacteal decline. I Demonstration of a precipitin of human milk serum —Gaetano **Viale** Variations of catalysis in the blood on high mountains —Marcello **Boldrini** Internal and external measures of certain long bones in man and in woman I Volume of the medullary cavity and the phenomena of circulation and respiration —Oliviero **Olivo** Commencement of the functional capacity of contractile tissues in the embryo of the chicken in relation to their structural and morphological differentiation II Functional and morphological differentiation of the myotome

Official Publications Received.

Annual Report on the Working of the Museum Department during 1923–24 Pp xi (Malta Government Printing Office)

Memoirs of the Asiatic Society of Bengal Vol 8, No 4. Plant and Animal Designs in the Mural Decoration of an Uriya Village, by Dr N Annandale, A Working Model of the Origin of the Ganges in a Temple in Ganjam, by Dr N Annandale, with Notes by Mahamahopadhyaya Haraprashad Shastri and Percy Brown Pp 239-256+6 plates (Calcutta) 4 8 rupees

Union of South Africa Journal of the Department of Agriculture, Vol 9, No 6, December The Annual Report of the Department of Agriculture for the Year ended 30th June 1924 Pp xviii+469-618 (Pretoria Government Printing and Stationery Office) 6*d*

Department of Agriculture, Trinidad and Tobago Administration Report of the Director of Agriculture for the Year 1923 Pp 19 (Port-of-Spain Government Printing Office) 8*d*

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Second Series (Geology), Vol 8, No 1 On the Fauna of the Anthracolithic Limestone of the Ômi-mura in the Western Part of Echigo By Ichirô Hayasaka Pp 83+7 plates (Tokyo and Sendai Maruzen Co , Ltd)

Empire Textile Conference Official Report of Proceedings of Conference held at the British Empire Exhibition, Wembley Park, Whit-week 1924 Pp v+267+100 (Manchester: The Textile Institute) 5*s*

United States Department of Agriculture Department Bulletin No 1217 Mixing Emulsified Mineral Lubricating Oils with Deep-well Waters and Lime-sulphur Solutions By W W Yothers and J R. Winston Pp 6 (Washington Government Printing Office) 5 cents

Annual Report of the Meteorological Committee to the Air Council for the Year ended 31st March 1924 (M O 267) Pp 61 (London H M Stationery Office) 1*s* 6*d* net

Union of South Africa Department of Mines and Industries Geological Survey Memoir No 21 on Magmatic Nickel Deposits of the Bushveld Complex in the Rustenburg District, Transvaal. By Percy A Wagner. Pp 181+22 plates (Pretoria Government Printing and Stationery Office) 7*s* 6*d*

Meddelanden från Statens Skogsförsöksanstalt Halfte 21, Nr 7 Grankottmatarna (*Eupithecia abietaria* och *Strobilata*) och deras Skadegorelse Av Paul Spessivtseff Pp 295-310 Halfte 21, Nr 8 Tragnagarestudier (Anobuden-studien) Av Ivar Tragårdh Pp 311-338 Halfte 21, Nr 9 (Slutnummer) Redorgörelse for Verksamheten vid Statens Skogsförsoksanstalt under år 1924 Pp 339-357 (Stockholm)

Department of the Interior United States Geological Survey Water-Supply Paper 517. Water Powers of the Great Salt Lake Basin By Ralf R Woolley Pp xvi+270+13 plates 30 cents Water Supply Paper 521. Surface Water Supply of the United States, 1921 Part 1 North Atlantic Slope Drainage Basins. Pp vi+294+2 plates 25 cents (Washington Government Printing Office)

Department of the Interior United States Geological Survey Bulletin 750 D New and Known Minerals from the Utah-Colorado Carnotite Region By Frank L Hess Pp 63-78+plates 4-11 Bulletin 750-E Deposits of Magnesia Alum near Fallon, Nevada By D F Hewett Pp 79 86 Bulletin 750-F Molybdenite in the Rocky Bar District, Idaho By Frank C Schrader Pp 87-99 Bulletin 751 C Geology and possible Oil and Gas Resources of the Faulted Area south of the Bearpaw Mountains, Montana By Frank Reeves Pp iv+71-114+plates 10 14 (Washington Government Printing Office)

Diary of Societies.

SATURDAY, JANUARY 24

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11 A M —Miss E M Blackwell An Outline of the Life History of *Phytophthora Cactorum*, Schroet —H R Briton-Jones The Diseases known as "Bark Canker" and "Die-back" of Fruit Trees —J Ramsbottom Fragmenta Mycologica (II)—Dr M C Rayner Sectoring in Cultures of *Phoma radicis-Callunæ* Rayn —E S Salmon The Epidemic Appearance in England in 1924 of a "Downy Mildew" of the Hop

MONDAY, JANUARY 26

ROYAL IRISH ACADEMY, at 4 15

INSTITUTE OF ACTUARIES, at 5 —C R. V Coutts Notes on Life Assurance Investment Policy

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Recent Discoveries of Fossil Man (IV) Neanderthal Man in Malta A Review of the Racial Characters of the Inhabitants of Southern Europe in later Pleistocene Times

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —S W Melsom and others Discussion on the National Physical Laboratory and its Work

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at the Great Northern Hotel, Leeds), at 7 15 —The Donnan Equilibrium in Chemical Industry —Prof H M Dawson The Donnan Membrane Equilibrium Hypothesis —W. R Atkin The Donnan Equilibrium in the Leather Industry —J B Speakman The Donnan Equilibrium in the Textile Industry —Prof N M Comber The Donnan Equilibrium in Soil Phenomena.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle on Tyne), at 7 15 —L H A. Carr The Use of Induction Regulators in Feeder Circuits

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at Institution of Mechanical Engineers), at 7 30

ROYAL SOCIETY OF MEDICINE, at 8 —G F Cale Matthews A Case of Long-standing Insomnia cured by the Extraction of Pulpless Teeth —L E Claremont. The Problem of Pulpless Teeth

ROYAL SOCIETY OF ARTS, at 8 —V E Pullen Radiological Research—a History (II) (Cantor Lectures)

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Brig-Gen the Hon C G Bruce and Major Northey Nepal

MEDICAL SOCIETY OF LONDON, at 8 30 —Prof A Castellani Parenteric Fevers

TUESDAY, JANUARY 27

ROYAL DUBLIN SOCIETY (in Royal College of Surgeons, Dublin), at 4 15 —G Brownlee. The Interpretation of certain Empirical Standards in their Application to Irish Butter —Prof E A. Werner The Decomposition of certain Amino-Acids by Alkaline Hypobromite

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4 30.—W R Dunlop Economic Research in Tropical Development, with Special Reference to British Guiana and British Malaya.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr H R Hall The Connexion and Relations of the Prehistoric Greek and Ancient Egyptian Civilisations (I)

INSTITUTION OF CIVIL ENGINEERS, at 6 —Dr E H Salmon The Southampton Floating Dock —F E Wentworth-Sheilds Southampton Floating Dock Subsidiary Works

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 7 —A. E Berriman A Review of the Rating Question

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —Sir Alexander B W Kennedy Petra

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates Meeting) (at Broadgate Café, Coventry), at 7 15 —L Jefferies Gearing

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Leeds University), at 7 30 —Prof G W O Howe World-wide Radio Telegraphy (Faraday Lecture)

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8 —J W T Walsh and others Discussion on The Effect of Internal Obstructions on the Performance of a Lighting System

WEDNESDAY, JANUARY 28.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Recent Discoveries of Fossil Man (V) France and Germany

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Section) (at 244 Deansgate, Manchester), at 6 30 —W D Williamson The Respective Spheres of Petrol, Steam, and Electric Commercial Vehicles

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at the Midland Institute, Birmingham), at 7.—Prof G W O Howe World-wide Radio Telegraphy (Faraday Lecture)

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7 30.—The Use of the Microscope in the Dairying Industry —Prof. R. S Williams The Microscope of Fundamental Importance to the Industry —N Wright The Structure of the Udder, Normal and Abnormal.—A. T R Mattick. The Differentiation of the various Cells found in Milk —L J Meanwell The Application of the Microscope to the Detection of Tuberculous Infection —J Golding Fat Globules. —Miss E R Hiscox The Separation and Identification of Micro-organisms causing Faults in Milk Products —J E Barnard The Elementary Principles of Microscopical Illumination (2) Self luminous Objects (Lecture Demonstration)

ROYAL SOCIETY OF ARTS, at 8 —C A Baker The Electrical Equipment of the London County Hall

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Mechanical Engineers), at 8 —B W Clarke, S G M Ure, and Prof J W Hinchley Studies in Filtration

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8 30 —Dr M D Eder Substitution

THURSDAY, JANUARY 29

ROYAL SOCIETY, at 4 30 —P M S Blackett The Ejection of Protons from Nitrogen Nuclei, photographed by the Wilson Method —R E Gibbs The Variation with Temperature of the Intensity of Reflection of X-Rays from Quartz and its Bearing on the Crystal Structure —R W Gurney (1) Ionisation by Alpha Particles in Monatomic and Diatomic Gases, (2) The Stopping Power of Gases for Alpha Particles of Different Velocities —Dr W E Curtis The Fulcher Hydrogen Bands —W L Webster The Magnetic Properties of Iron Crystals —*To be read in title only* —A E Ingham and J E Jones The Calculation of certain Crystal Potential Constants and on the Cubic Crystal of least Potential Energy—E C Stoner and L H Martin The Absorption of X Rays —F H Schofield The Thermal and Electrical Conductivities of some Pure Metals —M de Selincourt The Effect of Temperature on the Anomalous Reflection of Silver —T L Ibbs Thermal Diffusion Measurements

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg. The Properties and Structure of Quartz (I)

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7 —Prof C H. Desch Recent Developments in the Cement Industry

INSTITUTION OF WELDING ENGINEERS (at Caxton Hall, Westminster), at 8 —Sir W Peter Rylands The Philosophy of Welding

ROYAL SOCIETY OF MEDICINE, at 8 30 —Discussion Radiotherapy and Electrotherapy in Diseases of the Bladder and Prostate

FRIDAY, JANUARY 30

ROYAL DUBLIN SOCIETY, at 4 30.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Recent Discoveries of Fossil Man (VI) Recent Discoveries of Fossil Man in England and their bearing on the Early Distribution of Racial Types in Europe

INSTITUTION OF MECHANICAL ENGINEERS —Discussion Alternatives to the "Clash" Type of Change-Speed Gear for Motor Vehicles

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —P C W. King The Evolution of the Airship

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7 15 —A. J Broughall The Utilisation of Waste Steam

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institute, Middlesbrough), at 7 30 —F D Verrill Shipyard Pneumatic Plant and Pneumatic Riveting

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —E Ambrose Notes on High Voltage Electrical Transmission (Lecturette, Slides)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof J W Gregory The Mountain Structure and Geographical Relations of South-Eastern Asia

INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Section)

PUBLIC LECTURES.

SATURDAY, JANUARY 24

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SATURDAY, JANUARY 31, 1925.

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Editorial and Publishing Offices

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Early Activities of the Royal Society.

DURING the past twelve months NATURE has published, week by week, a column of selected extracts from Dr Birch's "History of the Royal Society," under the title of "Early Science at the Royal Society" Its commencement was the subject of an explanatory note in the issue of February 9, 1924 The series has run the allotted period, and now some kind of retrospect of the discussions, experiments, and policy of the circle of men who were the promoters of the Royal Society, and of experimental inquiry in general, may be of advantage

The series comprised the years 1660–87, an interval marking initial, yet fruitful, efforts to establish something that should be permanent in the English commonwealth of knowledge, something that should be shaped out and handed down to others as a reality The accounts (in brief) of schemes propounded and experiments performed will, it is hoped, have been the means of bringing readers of NATURE into the atmosphere of patient endeavour which animated the founders of the "New Philosophy" We can, all the more readily, picture them forgathering at Gresham College in harmonious conclave and intent True, as time proceeded, as mind encountered mind, weighty criticisms were offered, whilst dissensions, not quite of a milk-and-water type, arose, notwithstanding such intrusions, through all the same high resolve is maintained, the same sense of original responsibility is apparent. The grip of national conflict was over, perhaps forgotten, and things bespeaking mental awakening held indisputable sway. Harrington's contemptuous comment that they were, in early constitution, an assembly of men who had an excellent faculty of magnifying a louse and diminishing a commonwealth became empty and barren.

Inquiries in the departments of natural history, physiology (as understood), chemistry, medicine, mechanics, and astronomy were actively fostered, the last named especially. The vegetation of plants was frequently the subject of discourse. Evelyn's "Sylva" appeared in 1662 In 1673, Grew's microscopical observations of the texture of a piece of a walnut-tree section were discussed. The history of the silk-worm, in Latin, by Signor Malpighi, was sent in 1668, and ordered to be printed. The operator was directed to try again the feeding of spiders upon one another. In 1669, Robert Hooke (versatile and elusive, yet a veritable Master of the Ceremonies) produced a contrivance to see whether a mechanical muscle could be made by art, performing without labour the same office which a natural muscle did Robert Boyle presented his "Sceptical Chymist" in 1679, which a committee were to peruse to see what could be learnt

from it. Moray presented the stones taken out of the Lord Balcarres' heart, in a silver box, together with a written account of the dissection of his body, attested by a physician. Only, in case the deceased lord's mother should claim it, it was not to be denied her

Much time was taken up in discussing transfusion questions and arranging experiments But what are we to think of Dr Clarke's proposition that a man hanged might be begged of the King, to try to revive him, and that, in case he were revived, he might have his life granted him? In 1681 (Wren in the chair) it is recorded that Mr. Flamstead having cavilled against the method shown by Mr. Hooke of describing a parabola, the Society desired it again. Upon which the president declared it was true and certain. Honour to whom honour is due. Sir Robert Moray had presented from Prince Rupert an instrument of his Highness's invention for "casting any platform into perspective" It was ordered that the president (and others) wait upon the prince, return him the humble thanks of the Society, and show him an instrument of Dr. Wren's invention for casting any natural object into perspective. In 1666, Mr Peter Lely was moved to communicate curiosities in the art of painting Evelyn, Hooke (and others) were to meet and consider particulars Report was made of willingness to serve the Society We have, however, been unable to glean any issue.

His Majesty King Charles II. came upon the scene with a fanfare, thanks to the interest of Sir Robert Moray, the courtier, and the gentle scholarly Evelyn It was long hoped and expected that his Majesty, as founder, would attend one of the meetings. However, he never came "Early Science" speaks of the appointment of a committee to consider the manner of the King's reception and the conduct of chosen experiments, one being the contriving of optical pictures

There must, however, have been considerable personal intercourse with his Majesty. Christopher Wren was charged by express command to make a great globe of the moon On January 23, 1667/8, the operator was ordered to hasten the making of a thermometer for the use of the Queen. In the following year the president took notice that an experiment shown to the Society by Robert Boyle did not succeed at first at Whitehall, but at last it succeeded very well, and in his Majesty's presence "Early Science" has omitted a pathetic story. In 1663, in a discussion of a new way of hatching pigeons, Sir Robert Moray was able to relate that the King, *when very young*, meeting with a blackbird's nest, and finding but one young one in it, carried it home in the nest, and put it to a thrush in a cage, who fed the blackbird as carefully as if it had been her own, but with this difference, that whereas other birds fed their young ones just before they feed themselves, the thrush fed herself before the blackbird.

The Society enjoyed the supreme advantage at its foundation, and for fourteen years, of the secretaryship of Henry Oldenburg This accomplished man, a Latin scholar and able linguist, laboured indefatigably and exclusively in its interests with a true spirit of service With extraordinary zeal he maintained a voluminous correspondence with philosophers abroad, and hence linked up and broadened the philosophical learning of his time He would seem to have done his best to avoid the credulous and trivial

Foreign visitors came ever and anon, providing a useful interchange of views The Danish Ambassador was brought by Evelyn on February 13, 1660/1, and was given a sight of Mr Boyle's air-pump The Genoese Ambassador came on January 29, 1661/2. Leibnitz was present at the meeting of January 22, 1672/3 (Hooke, Boyle, and Oldenburg were there). The following year he was elected into the Society. Huygens was elected on June 22, 1663, at the same time as Sorbière (who afterwards narrowly escaped being struck off the roll) The Moroccan Ambassador was a visitor in 1682 and inscribed his name in the charter-book in Arabic Later, he was responsible for an account of a person who was always dumb, except at noon! The Florentine envoy came in 1685 and was entertained by Papin

The president and officers were at one period gravely concerned over the arrears of subscriptions, a very large total liability having arisen by degrees Various fellows undertook to approach the forgetful ones. Not much advance was made in the case of Edmund Waller, the poet, though certainly his interest in the organisation was no more than dilettante It was mentioned that he had put it off with an expression of merriment; that he thought it best to forget and forgive one another for what was past, and to begin on a new score This was very disturbing to Oldenburg. In point of fact, Waller never did pay.

Pepys was elected February 15, 1664/5, and admitted the same day. On January 14, 1674/5, at a meeting at which Mr. Pepys and the Earl of Aylesbury were present, each took a day when they would provide a lecture for the Society. The latter excused himself, subsequently paying a fine of forty shillings. Although not recorded, it would appear that Pepys failed to keep his promise. We have found no reference to this lapse in the well-known Diary.

Limitations of space forbid further review; and so we take leave of these "early philosophers," grateful for efforts which shaped into actualities, and for their rich legacy of an essentially English foundation.

T. E. JAMES.

The Physiology of Colour-Change.

The Pigmentary Effector System: a Review of the Physiology of Colour Response By Dr Lancelot T. Hogben (Biological Monographs and Manuals) Pp xi+152 (Edinburgh and London · Oliver and Boyd, 1924) 10s 6d net

AMONG the many unsolved problems of animal life, the significance of pigmentary colour and of rapid colour-change is one of the most elusive and attractive Unlike the case of chlorophyll, the pigments of animals have no direct physiological value so far as really critical evidence goes at present The colouring matters of birds' eggs, for example, the variable colouring of the egg of the guillemot, herring-gull, or cuckoo, has not yet been shown to possess the slightest relation to the welfare of the chick; nor has the (genuine) coloration or lack of colour in the skin or deeper tissues been proved conclusively to play a definite part in the welfare of the animal body. On the other hand, adaptational and survival value has been freely admitted, until recently, to account for the complex and exquisitely balanced correlation between coloration, habit, and environment in a large number of instances, of which insects and fishes offer the most notable examples The difficulty that has made biologists sceptical of arguments that are used to prove protective, warning, and epigamic significance in animal colouring, lies in the absence of objective standards of excellence How much does it benefit a flat-fish to fit so exactly into its niche and to stay there? How much does the note of warning avail? What was the value of the rough study in pigment before the painted animal canvas became amenable to the criticism of life? Are pigments or structural colours anything more than indices of chemical and physical structure, and is their biological value real or apparent only?

To these questions Dr Hogben's book offers no direct answer, and much more analytical work has to be done before we can put really intelligent questions about animal coloration to the test of experiment and observation What this excellent book does, is to analyse critically all that is accurately known about those quick changes of colour for which the chameleon has gained a wholly undeserved notoriety and in which it is excelled both in rapidity and range of repertoire by many fish, frogs, prawns, and cuttle-fish Dr Hogben's book is a critical review of the factors governing colour-change in vertebrates and Crustacea, and his special qualifications for this work lie not only in his own original contributions to experimental chromatology, but also in the judicial way in which he deals with the evidence and shows in each case what the problems are that now await solution. Such a survey will only require to be known to be at once appreciated by zoologists and physiologists as an indication of the new *rapprochement* that is taking place between these two bodies of workers, and that constitutes a reversion to that earlier practice when, as the editors of this series remark in their preface, "animal physiology was not yet divorced from morphology"

Colour-change is a response by the pigment cells of the skin to change in the external or internal environment It takes the form of radiation of pigment, or of pigmented protoplasm, from the body of the cell into its spreading branches, an injection as it were of granules into a pre-existing dendritic pathway When this occurs the general effect is darkening of tone. The frog, for example previously yellow, now becomes dark green or almost black Again, the change may be one of pallor occasioned by the inflow of pigment from the branches into the central cell-body leaving, therefore, relatively large tracts of skin uncoloured or exposed so that the less mobile but lighter coloured groundwork—the body of the colour-scheme—becomes thereby visible Such changes of coloration may be general or local They may be slow or almost instantaneous They may occasion a passing flush or a momentary pallor, or they may persist so long as the animal that exhibits them remains in a chosen habitat They may come on at night and again at daybreak, and the rhythm of nocturnal and diurnal colour contrast may persist even when day is turned into night or night into day As Lord Lister said in his classical paper on "The Pigmentary System of the Frog" (1858), the pigment cells "form a tissue with entirely new functions which, though apparently allied to the most recondite phenomena, yet produce very obvious effects"

Dr Hogben's book is a commentary on these prophetic words. The pigmentary tissue gives evidence, accumulated now from the side of endocrinology as well as from those of neurology, of ecology, and of toxicology, of being "allied to the most recondite phenomena" Lister advocated the colour-changes and pigment-cells in the frog for use as "indicators" of the effects of poisonous substances on the animal organism It has taken exactly sixty years for his suggestion to be carried into effect. The chromatophores of the frog and of the fish are now the most delicate tests of reaction to physiological and pharmacological stimulation, and as there exists a close if not an exact correlation between the action of drugs on a given tissue and those of the sympathetic and para-sympathetic (or in the modern sense the "autonomic") nervous systems, change of colour—the radiation and

retraction of pigment in the cell—acquires merit not only in itself as a biological factor, but also as a sign-post in the maze of hormonic and autonomic changes that take place in the body.

As an example of this modern development of chromatology we may take the case of an American fish Fundulus Spaeth has shown that the tissue overlying a few detached scales and containing the mobile chromatophores can be studied in a living state under the microscope and the reactions of these pigment cells to various agencies can be recorded. Normal saline promotes expansion of the pigment into a dendritic form, whilst potassium and alkaline salts generally cause immediate retraction These opposing effects can be balanced by using three reagents in suitable combination (NaCl 6 vol + KCl 1 vol + $CaCl_2$ 0 35 vol, N/10 in each case) Equilibrium having thus been attained, it is now possible to determine the effect of any given pharmacological reagent quantitatively by measuring the time taken by, and the extent of, pigmentary response. In this way, Spaeth has accomplished a pharmacological assay, and in the course of it he has discovered the remarkable effect of barium chloride (N/10) When this is applied to the pigmented tissue, the granules at once flow centrally and remain retracted for half an hour Then the chromatophores at the edge of the scales suddenly radiate their pigment but almost immediately retract it again There then follows a "Piccadilly effect" The pulsations begun by the cells at the edge of the scale, spread centripetally from cell to cell, increasing in amplitude of vibration as time goes on Eventually the whole group of pigment-cells associated with each scale pulsates for several hours between the extremes of contraction and expansion.

The importance of these observations and of others on the effect of ergotoxine and adrenalin lies in the fact that the pigment-cell of the fish has one sympathetic nerve-ending and probably one only. Moreover, the pigment-cell, if not a modified smooth muscle-fibre, is a member of a closely allied "effector system," and the evidence it supplies as to the action of drugs and of hormones (such as ergotoxine and adrenalin respectively) throws light upon the action of these substances in the roots of the mammalian uterus It is indeed an unexpected development of biological research to find the study of pigment a help to the gynæcologist

The general conclusions that Dr Hogben draws from his study of the factors governing colour-response in the lower vertebrates and Crustacea are based on a critical examination of the evidence In the Amphibia, he concludes that the pituitary (posterior lobe) is the source of the effective stimulating substance that, in correlation with the action of natural stimuli, regulates colour-response; and that nervous control of the chromatophores, even if it exists, plays a very subordinate part. In fishes the weight of regulation lies, on the contrary, with the nervous system and owes little to hormonic influence. In reptiles, pallor is the result of adrenalin affecting the chromatophores, but the flushing of the skin with colour is not clearly understood Finally, the factors for colour-change in Crustacea are ably dissociated and set out on the basis of Gamble and Keeble's work on Hippolyte, and the work ends with a short appendix on the chromatophores of cephalopods

The volume, from its style, critical treatment, and breadth of view, should enhance the author's reputation and give encouragement to the editors and publishers to pursue the excellent object they have in view—the production of monographs on experimental biology by those who have something to say and are able to say it F W GAMBLE

The Recognition of Minerals by their Optical Characters.

(1) (a) *Les méthodes de Fédorof et leurs applications à la détermination des plagioclases.* Bull Suisse de Minéralogie et Pétrographie, tome iii fasc 1-2, par L. Duparc et M. Reinhard, 1923 (b) *La détermination des plagioclases dans les coupes minces*, Mémoires de la Société de Physique et d'Histoire naturelle de Genève, vol 40, fasc 1, par L. Duparc et M Reinhard, 1924

(2) *Mikroskopische Physiographie der petrographisch-wichtigen Mineralien* Begrundet von H Rosenbusch. Band 1. Erste Hälfte: Untersuchungsmethoden Funfte, vollig umgestaltete Auflage, von Prof. Dr E. A. Wulfing Zweite Lieferung Pp. iv + 253-532. (Stuttgart E. Schweizerbart'sche Verlagsbuchhandlung G.m b H, 1924.) n p.

THE employment of crystal optics in the determination of minerals is a very special branch of applied physics which has been industriously pursued in recent years, but it is the task of distinguishing between the different plagioclases that has called for the greatest refinements. These important constituents of igneous rocks present the closest resemblance to one another, but vary greatly in composition, forming a continuous series from albite, soda plagioclase rich in silica, $Na_2OAl_2O6SiO_2$, to anorthite, lime plagioclase, $CaOAl_2O_32SiO_2$, which contains much less. They differ, however, in the orientation of their axes and planes of optical symmetry relatively to their crystal structures, and in other optical characters. The foundations of these investigations were laid by Schuster,

in Germany, and Michel Lévy in France, but it is to the great Russian crystallographer Fedorov and his pupil Nikitin that we owe the latest and most far-reaching developments, and they have now been rendered generally available by Duparc and Reinhard in Switzerland, and by Wulfing in Germany, in the works before us

For this purpose a microscope with a theodolite stage is employed, that is to say, one in which a thin rock slice, containing a section of plagioclase, can be rotated successively on at least three different axes at right angles to one another, so that, with the help of glass hemispheres to prevent refraction, it may be examined from any direction As the amounts of these rotations are recorded on graduated circles or arcs, the resulting position is exactly determined

It is well known that plagioclase almost invariably occurs in twin crystals consisting of at least two differently orientated component parts, which are related by the fact that a rotation of one of them through an angle of 180° about a definite direction, the twin-axis, will bring it into parallelism with the other There are a number of different kinds of twins of plagioclase, each with its characteristic twin-axis, but it is by no means always easy to say which is present.

By a series of manipulations of the theodolite stage the three axes of optical symmetry, the so-called "axes of elasticity," with the refractive indices α, β, γ, of one of the components of the twin crystal are brought in turn into a position parallel to the external horizontal axis of rotation of the theodolite stage, and their positions relatively to the normal to the thin rock section are read off on the graduated circles or arcs These axes of optical symmetry are represented by three points on a stereographic projection in which the normal to the rock slice is the centre of projection

The same procedure is followed with regard to the other component of the twin, and the three corresponding points are inserted in like manner on the same projection. If now great circles are drawn through each of the pairs of points representing corresponding axes of optical symmetry, the three great circles will meet in two opposite points, only one of which will as a rule be represented on the projection Such a point (or points) will represent the twin axis, and its angular distance from the axes of optical symmetry is then measured, but so that if it exceeds a right angle the supplement is taken

Recourse is now had to another stereographic projection This is on tracing paper, and in it the point representing the intermediate axis of optical symmetry with refractive index β occupies the centre, and the other two with refractive indices γ and α are on the circumference at a distance of 90° from one another. The position of the twin axis can now be indicated, because its angular distances from the three axes of optical symmetry are known They are of course the same for both components of the twin The new projection is next compared with a standard projection on the same principle, which will be found in the works referred to above It shows the positions relatively to the axes of optical symmetry of the crystal directions of the plagioclase, especially the twin axes Instead of the crystal directions being considered as fixed, and the optical directions as varying with the composition of the plagioclase, exactly the opposite convention is adopted, the axes of optical symmetry being regarded as fixed and the crystal directions as varying with the composition The position of the point representing the twin axis of a twin according to any particular twinning law will therefore vary with the composition of the plagioclase, and the points representing such a twin axis in all the different plagioclases will form a curved line, one end of which will correspond to albite and the other to anorthite The intermediate points corresponding to plagioclases with 10, 20, 30, etc of anorthite are figured accordingly The standard projection shows a number of such lines, each corresponding to a particular kind of twinning

By placing the tracing paper with the projection of the twin axis under investigation over the standard projection so that the corresponding axes of optical symmetry coincide, and noticing (1) on what line in the standard projection the twin axis in question falls, and (2) on what part of that line, it is known at once (1) what is the nature of the twinning, and (2) what is the proportion of anorthite present in the plagioclase.

The optical axial angle is also obtained in the course of the investigation

In the publications by Duparc and Reinhard this method is explained with a wealth of diagrams and examples, and the older methods are also fully described and illustrated in greater detail than by previous authors A full and clearly illustrated account of the Fedorov method is also given in the Stuttgart publication This forms, however, only a small section of the new edition by Wulfing of the great classical work by Rosenbusch on microscopical petrography It contains in addition a thorough exposition of the general theory of the microscope, of which petrologists, as a whole, know far too little. Considerable space is devoted to the description of different types of petrological microscopes and their accessories and their use. The high standard of previous editions is maintained and even surpassed, for all the latest advances will be found in its pages. JOHN W. EVANS.

The British Portland Cement Industry.

A Hundred Years of Portland Cement, 1824–1924 By A. C. Davis Pp xxii+282 (London. Concrete Publications, Ltd., 1924) Cloth, 21*s* ; leather, 25*s*

SOME books are of transient value and others increase in value as time progresses This work undoubtedly belongs to the latter class. The author's intimate knowledge of the cement industry, its complex business ramifications, and changing methods of manufacture, has enabled him to produce a book which must be regarded as authoritative over the period of which it treats, so far as the British industry is concerned No attempt is made to follow the development of the industry in other lands, beyond what is essential for understanding it in our own

After a brief survey of the knowledge of the ancients regarding limes and cements, and a critical examination of John Smeaton's work in 1756, the tangle of men and names associated with the beginning of the industry in different parts of England is gone into in considerable detail, this section of the work being illustrated by excellent actual photographs of historical value The cement industry is now so rapidly changing that all these old landmarks of progress may in the near future be swept away, and the men who took an active part in its development and remember the conditions which prevailed in the industry even a few decades ago are now fast disappearing The work, therefore, is valuable in that it gives an accurate account of the industrial conditions and influences which prevailed in the industry, following the gradual change until we reach modern conditions, when great accumulations of capital, expensive machinery, and accurate scientific control by routine chemists and scientific engineers are essential for successful manufacture

What must strike the reader of this book is the unattractive personality and lack of education of the pioneers of the industry. The work of Joseph Aspin, and especially of his son William, is gone into in some detail. Did any of the Aspins really know how to produce the substance known now as portland cement, a substance which is produced by increasing the heat in the kilns sufficiently to cause the intimate union of the components accompanied by semi-fusion or "sintering"? The author decides that they did not The original patent of Joseph Aspin is obviously deficient, and it has been suggested that the inventor suppressed vital information in order to mislead competitors. Mr. Davis decides that the Aspins never made what was now known as portland cement, although Joseph Aspin introduced what has proved the extremely successful trade name of "Portland Cement," and in this showed considerable ability The fact of the matter is that both the Aspins were ignorant but gifted men, deficient in education and devoid of all scientific knowledge

Joseph Aspin, the father, was a bricklayer by trade, a Yorkshireman, who seems to have distrusted his fellow-manufacturers to a considerable extent, as he surrounded his factory with walls 20 ft. high and carried on the manufacture as a sort of mystery His son William continued this tradition, mystifying his workmen by sprinkling various secret chemicals from a tray on to the contents of the kilns in front of his workmen, with the result that he not only repeatedly succeeded in raising capital after each failure, but also succeeded in baffling inquiries right to the end. After repeated failures he died in Germany as the result of a fall while in an intoxicated condition, his last partner having got rid of him by a cash payment of 2500 marks

This origin is no doubt the cause of the suspicious attitude towards all people who claim superior knowledge, which even to-day prevails to some extent in the industry, chemists and scientific workers generally being regarded with marked disfavour

A man of greater ability than either of the Aspins was I C Johnson, who spent some time in spying around Aspin's works with the view of discovering his "secrets" He apparently quite met his match in the Yorkshireman, because the sample of material that Aspin supplied him with turned out to consist largely of calcium phosphate, which led Johnson to collect all the bones in his neighbourhood and burn them so as to create a mighty stench Needless to say, he did not make portland cement with this material, but promptly silenced any criticism by blaming the analyst for making an incorrect analysis

Johnson himself seems to have possessed only elementary scientific knowledge, but his ability was undoubted, and by means of numerous experiments made on the "trial and error" principle, he undoubtedly succeeded in making portland cement as we know it to-day He also introduced the chamber kiln into England, and the enormous British industry which developed was largely due to this invention

The cement industry seems to have been carried on in the crudest way, without scientific control of any sort, and a graphic description of the way a cement works was run in 1886, on p. 211, brings this aspect home to the reader, especially when a chemist will remember that at this time the German chemical firms for years past had been not only employing routine chemists to control output, but also, so far back as 1883, the Badische Anilin und Soda Fabrik was actually employing a director of scientific research at a salary of 5000*l* per annum.

It was the shock of foreign competition which led to

improved methods of manufacture Routine chemists were engaged to control output and material, the rotary kiln was reintroduced from the United States (after its initial invention and failure in Great Britain), and, generally, the industry took on its modern form The author claims, and the reviewer thinks correctly, that at the present time the British cement industry is conducted with practical skill and accurate scientific control which equals, if it does not exceed, that exercised by any other country, but that great improvements are still possible in manufacture

The author furnishes an interesting chapter on the progress of scientific research in the industry. To sum up, the work is a valuable one, and gives an exact and very accurate picture of the cement industry as it exists to-day, and illustrates clearly the successive changes introduced into the industry in the successive decades The work will enhance the author's reputation as one of our leading authorities on cement

GEOFFREY MARTIN

Prehistoric Man.

Fossil Man in Spain By Prof Hugo Obermaier. (Published for the Hispanic Society of America) Pp xxviii + 495 + 23 plates (New Haven · Yale University Press, London Oxford University Press, 1924) 23*s* net

DR HUGO OBERMAIER was born in Bavaria, worked under Hoernes at Vienna, studied glacial geology throughout the Alps with Penck, excavated for the Prince of Monaco the largest and most important prehistoric dig at present known at Castillo (Cantabria); was professor, until the War broke out, at the Institute of Human Palæontology founded by the same Prince at Paris, and now is professor of prehistoric archæology at the University of Madrid. With such a record we may well expect a fine work and Dr Obermaier has not disappointed us. To the German thoroughness and power of taking pains in details born in him, there has been added, from long association with the French, the Latin clarity of thought and power of intuition. Madrid has done well to envisage all this and come forward with a professorial chair when war difficulties approached. It is not too much to say that Dr Obermaier is one of the two most learned prehistorians now alive.

It was in 1912 that his book "Der Mensch der Vorzeit" appeared, and this was followed in 1916 by "El Hombre Fosil," with a translation of which from the Spanish into English, accomplished thanks to the enterprise of the Hispanic Society of America, we are now concerned. It is a monumental work that will long retain a foremost place in the prehistorian's library, though no specialist has heretofore been able to do without the original Spanish edition. A few changes have been introduced in the new version and the book has to a large extent been brought up-to-date. This has been facilitated by the fact that, owing to innumerable delays in the United States, the production of the English edition is coinciding in time with the preparation of a second revised edition in Spanish, and it has been found possible to incorporate some of the new matter in the present volume. There are also alterations and additions in the plates, which are many and excellent In the reviewer's opinion the English title is somewhat misleading, as the work is really of a general character, though stress is laid in the illustrations and text on the Iberian peninsula—"Fossil Man, with special reference to Spain" would really be a more accurate description.

The book opens with an account of Tertiary times and the problems of Tertiary man, followed by an exceedingly able summary of the existing knowledge of the Glacial epoch with lists of the plants and animals found[1] Next comes a description of the various Palæolithic industries, a special chapter being devoted to the Iberian peninsula during these times It is pleasant to see here the introduction of a new plate figuring a general view of the cave of Castillo, where the reviewer had the privilege of assisting at the digging of this really wonderful site under Dr Obermaier's direction Palæolithic art and the problems of chronology are then discussed, and the volume concludes with two chapters on fossil man and the transition from Palæolithic to Neolithic times successively. Not the least valuable part of the work is the group of appendices, notes and bibliography, which, in the English edition, are separated from their respective chapters and placed together at the end Some minor changes in arrangement have been introduced which seem to be on the whole an improvement. Thus the order of the table on page 64, giving the archæological sequence of the various industries in the Somme valley, has been reversed from that of the Spanish edition, the latest deposits being placed at the top instead of at the bottom of the list. There are also one or two minor misprints of little importance, for example in the initials of at least one author quoted

Of course, in any work of this nature there must be, besides basal and incontrovertible facts, theories which are not necessarily accepted by every one. For example, Dr Obermaier's suggestion as to the significance of the Azilian painted pebbles, that the markings really represent conventionalised human figures, has always seemed to the reviewer difficult of credence; and his

[1] A translation of the whole of this chapter from the Spanish edition is given in the appendix—the main text contains a rewritten version not quite so overloaded with technicalities and mere lists

comparison of them with the undoubted conventionalised figures of the Spanish Third Group paintings seems open to the objection that there is by no means an exact similarity, and, moreover, that the latter are very possibly of a much later date However, these are points that further finds will no doubt elucidate.

It only remains once more to congratulate Dr Obermaier on his book, and the Hispanic Society of America on having been the instrument of introducing it more fully to English readers. M C B

Fluid Velocity and Pressure.

The Measurement of Fluid Velocity and Pressure. By J R. Pannell. Edited by R A Frazer Pp vii+135 (London: E. Arnold and Co, 1924) 10*s* 6*d*. net.

TO a large extent this book is a product of the advent of aeronautics, and its preparation would not have been possible fifteen years ago The author passed through the period during which no accurate means existed of measuring the velocity of fluids, and was intimately associated with the history of the needs of such methods as he describes. At the present moment, the calibration of anemometers depends on a solitary series of absolute measurements at the National Physical Laboratory, part of which was conducted by the author himself. The work of Stanton on wind pressure in 1903 was the first contribution to the production of the tube anemometer illustrated on p. 13, its establishment as a satisfactory standard followed the formation of an Aeronautics Department, and the development then reached the stage at which a skilled workman can reproduce the instrument so accurately as to give speed within one per cent. without special test.

Many other anemometers, including those established in aeronautical practice, are described together with manometers and balances for the measurement of fluid pressures. In the description of one of the manometers —p 92—the short statement occurs that "the horizontal tubes are filled with a solution of distilled water and common salt of density 1·07 . . ." and no reference is made to the lengthy inquiry made by the author before this solution was decided on In the early days of the use of tilting manometers of the Chattock type, distilled water was tried, with the result that renewal was necessary after each fortnight or three weeks The glass work had then to be thoroughly cleaned As a result of Pannell's efforts the period between cleansings was raised to a year or more and the operation of cleaning greatly facilitated In this and in much of the material in the book under review there is just that precision of detail which is helpful to newcomers and will enable them to get to work quickly and safely

Pannell lost his life when the airship R38 failed, whilst applying his knowledge of instruments to research, and together with his colleagues the author has left a record of which one is proud and of which this book is one item The volume can be confidently recommended as an excellent statement of available methods of measurements in the motions of fluids, whether the application be in aeronautics, hydraulics, ventilation, or any other of the branches of engineering.

L BAIRSTOW.

Our Bookshelf.

Soil Management By Prof Firman E Bear (Wiley Agricultural Series) Pp vi+268 (New York: J Wiley and Sons, Inc , London · Chapman and Hall, Ltd , 1924) 10*s* net

THE work under notice is a text-book dealing with the application of scientific facts and principles to the practical management of the soil, and is written for the use of students in agricultural colleges who have already taken courses in chemistry, botany, geology, and physics The requirements of crops and the properties of soils are discussed in the first ten chapters, which are followed by four chapters on the utilisation of the resources of the soil by cultivation operations, crop rotations, etc The remainder of the book is concerned chiefly with the economic use of fertilisers and of lime The nitrogen problem is treated with the thoroughness that would be expected from Prof Bear, who has devoted much time to this question It is a very common practice in the United States to purchase only phosphatic fertilisers and to depend on the air for nitrogen, on soils which have been cultivated for many years, such a system necessitates the well-managed introduction into the rotation of frequent leguminous crops for green-manuring, and the author is rightly insistent that every effort should be made to utilise such natural nitrogen-fixing agencies to the fullest possible extent for the maintenance of soil fertility

The illustrative data are taken mainly from American sources, but the application is by no means confined to American conditions. It may, however, be questioned whether the book is not on the whole too advanced for students who "have little or no need for the course except as it may be useful to them in practice or in understanding practice" Certainly the average British student of this type will find it rather stiff reading; but his American cousin is perhaps different C. T G

The Bombyliidæ of the Ethiopian Region · Based on Material in the British Museum (Natural History). By Mario Bezzi Pp. viii+390 46 text-figs. (London: British Museum (Natural History), 1924) 32*s* 6*d*

THE Bombyliidæ are a large and highly interesting family of Diptera, and the present monograph forms an important contribution to our knowledge of these insects In placing the preparation of the volume in the hands of Prof Bezzi, a wise choice has been exercised,

since that author is well known as one of the leading dipterists of to-day. The book is based upon material submitted to him by the British Museum and the Imperial Bureau of Entomology as well as from the Museums in Cape Town, Buda-Pest, and Genoa, and also from Messrs. Alluaud and Jeannel in Paris. This wealth of specimens, together with those in the author's own collection, has made it possible to produce a monograph of great value. In addition to diagnostic keys and descriptions, all available biological data, however scanty, is included under each species together with notes on the known life-histories. It is hoped that, with the aid to identification thus provided, African entomologists will be stimulated to study the remarkable metamorphoses of these insects. Their larvæ are all parasites and have a wide range of hosts. The unexpected discovery of *Thridanthrax abruptus* parasitising the puparia of tsetse-flies is but a bare indication of what awaits investigation in the Ethiopian region. The book is admirably printed and illustrated, while the revision of the English manuscript by Major Austen has ensured this arduous task being carried out capably.

Distillation du bois. Par Prof. G. Dupont. (Encyclopédie Léauté, 2e série.) Pp. xv+284. (Paris: Gauthier-Villars et Cie.; Masson et Cie, 1924.) 25 francs.

THE general treatment in this work is on somewhat similar lines to that followed in recent British and American text-books on the subject. Special attention is given to the distillation of resinous woods, and an interesting account of wood distillation plants is included, the text being made clear with numerous diagrams. There is a certain lack of proportion in the presentation of facts. Nearly one-third of the book is given over to an account, such as is available in numerous organic text-books, of the elementary chemistry of acetic acid and methyl alcohol, and of simple derivatives of these, yet the study of the gaseous products from the thermal decomposition of wood is intentionally neglected. Again, the analytical section is considerably restricted. The space occupied by this important subject is only half that given to the preparation and properties of formaldehyde, and it is doubtful if the meagre information therein contained will be of much real value to the analyst.

The monograph cannot be regarded as a handbook for the specialist. It is rather a general account of certain aspects of wood distillation presented in a form which will be attractive to the general reader and science student. J. REILLY.

Aristotelian Society. Supplementary Vol. 4: *Concepts of Continuity: the Papers and Symposia for discussion at the XIVth Joint Session of the Aristotelian Society and the Mind Association, at University College, Reading, July 11-14, 1924.* Pp. vi+240. (London: Williams and Norgate, 1924.) 15s. net.

THE papers read at the summer meeting of the Aristotelian Society and the Mind Association, though inspired with a distinctively philosophical motive, are of more than usual scientific interest. All in some form deal with the subject which gives the title to the volume, the concept of continuity.

Prof. Chevalier's article "Le Continu et le Discontinu" is designed to prove that though the problem of continuity is fundamental in mathematics and physics, it can be resolved only by philosophical arguments.

Three of the five symposia deal with scientific problems. One on the quantum theory discusses how far it modifies or can be made to accord with the definitions of continuity accepted in mathematics, physics, and psychology. The papers are by Dr. Nicholson, Mrs. Wrinch-Nicholson, Prof. Lindemann, and Prof. Wildon Carr. A second deals with the biological problem of the transmission of mental characters. This is discussed by Profs. Johnstone, Dendy, MacBride, and Lloyd Morgan. A third deals with the implications of the term "law" in psychology. The papers are by Mr. Wolters, Dr. M'Intyre, and Dr. Levine.

Chemical Thermodynamics: an Introduction to General Thermodynamics and its Applications to Chemistry. By Prof. J. R. Partington. Pp. vii+275. (London: Constable and Co., Ltd., 1924.) 10s. 6d. net.

A NEW edition of Prof. Partington's "Text-book of Thermodynamics with special reference to Chemistry" (1913) has been desired for some time, and those who are familiar with that work will welcome it in its new form under the title "Chemical Thermodynamics." The treatment has been simplified as well as brought up-to-date. Any one who is familiar with the large number of relevant papers published during the past decade will marvel at the skill with which the material has been incorporated. The author has made a special feature of the inclusion of much recent work published in American journals. "The accurate experiments, and the ingenious and original treatment, of the American workers on this subject will make all admit gratefully the debt which students in other countries owe to them." A point which teachers will appreciate is that the equations have been stated, so far as possible, in a form capable of direct numerical application, and many examples, with answers, have been provided. It is a convenience to have the numbers of the paragraphs printed on the inside edges at the tops of the pages. The book will prove indispensable to students of chemistry and physics alike.

Spectroscopy. By Prof. E. C. C. Baly. (Text-books of Physical Chemistry.) In 2 vols. Third edition. Vol. 1. Pp. xi+298. (London: Longmans, Green and Co., 1924.) 14s. net.

THE new edition of Prof. Baly's "Spectroscopy" is modelled closely on the original plan. It has, however, been reset in a new *format* with a larger page, so that the number of pages in the first volume of the new edition is about 10 per cent. less than in the corresponding half of the preceding edition. Since the earlier portions of the book are concerned mainly with prism and grating spectroscopes, they have not needed any drastic emendation as a result of the recent developments in the theory of spectroscopy; but attention may be directed to a useful table of standard wave-lengths, covering three pages of the new edition, and to the account that is given of recent work by McLennan and by Millikan on the extreme ultra-violet region of the spectrum.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Limbs and Pigment-Cells.

I NOTICE in a review of Franz's "Geschichte der Organismen" which appeared in NATURE of December 20 a reference to the interesting evolutionary problem of the origin of the limbs of vertebrates I have no intention of essaying the futile task of endeavouring to influence those whose minds are already made up regarding this problem, but I should like to direct the attention of others to the point that new facts having important bearings upon the problem have come to light in the investigation of the development of these relatively archaic types of vertebrate, Lepidosiren, Protopterus, and Polypterus A short summary of these facts, and of the conclusions they suggest, will be found in my volume on vertebrate embryology, and the perusal of this summary will, I think, suffice to indicate the grounds for my belief that the older hypotheses referred to by the reviewer will, as knowledge of the relevant facts becomes diffused, be replaced as working hypotheses by the newer view that the limb of the vertebrate has evolved out of a projection from the body-wall which was primitively respiratory in function

I take this opportunity of directing attention to another statement in recent literature which is liable to cause misunderstanding It occurs in a book by Dr. L. T Hogben entitled "The Pigmentary Effector System," where he refers (p 93) to "Kolliker's work on the South American mud-fish, Lepidosiren" The creature upon which Kolliker worked was of course not the creature known to us to-day as Lepidosiren, not the South American "mud-fish," but the African Protopterus which for a brief period after its discovery was called Lepidosiren. As Dr Hogben does not refer in his summary of our knowledge regarding the pigment-cells of fishes either to what I have published on the subject, or to what I made known to him by word of mouth, I will state very shortly the attitude that my work upon Lepidosiren caused me to take up, and which I have consistently adopted in teaching for many years I adhere to the view that the colour change, so beautifully exemplified by the young Lepidosiren—of a deep rich black during the day and practically colourless during the hours of darkness (see Phil Trans Roy. Soc B, 192, 1900, and *Quart Journ Micr Sci* 46, 1902), is due to actual change in the form of the black pigment-cells which, under the influence of light, push out their finely branched pigment-laden pseudopodia in a direction parallel to the surface of the body so as to provide a light-proof coat, and, when night falls, draw in their pseudopodia and shrink up to spheres so relatively small as to be without effect upon the general colouring The considerations which induced this opinion were (1) the appearances presented under the microscope, (2) the fact that the pigment-cells changed their position in the body and therefore necessarily had the power of moving their pseudopodia, and (3) the fact that it was possible by teasing up the night skin to isolate individual chromatophores without their going to pieces as they would be liable to do were peripheral extensions of their body torn through in the operation

As regards the active functioning of the pigment-cells, there is, I think, a tendency towards over-emphasis of one or other of the factors involved. There is, first of all, the fact that the healthy activity of the chromatophores, as of all other cells in the body, is dependent upon the internal medium of the body being of approximately "normal" composition, and recent work by various investigators, including Hogben, has served to emphasise the special importance of particular components of the internal medium provided by the adrenal or the pituitary organ, slight fluctuations in the proportion of this particular component evoking specific functional responses. There is, secondly, the nervous factor, and there is, thirdly, the direct influence of light.

As regards the latter, I may quote an observation made by me in South America I happened to be watching a green tree-frog in the sunlight and admiring the extraordinarily perfect agreement between its colour and that of the surrounding leaves. Across its back fell a dark narrow bar of shadow caused by a blade of grass close by When I caused the tree-frog to change its position it appeared, to my astonishment, to carry the shadow with it, the position where it had been remaining for some little time clearly indicated by a dark band across the green surface That observation served to impress upon my mind very vividly the fact of response by the skin chromatophores to localised light stimulus, and while such responses may turn out to be complicated reflexes involving the central nervous system, it seems to me simpler, until convincing evidence to the contrary is produced, to regard them as direct cellular reactions to changes in the incidence of light rays

J GRAHAM KERR

The University, Glasgow,
December 22

Muscular Action.

DURING the last few years a considerable number of papers have appeared bearing on this subject. They may be divided roughly into two classes, the first dealing with the fatigue caused by muscular action, together with the nature of the accompanying waste products, the second, with the behaviour of isolated muscles under the action of artificial stimulus.

From a mechanical point of view, a muscle is a single-acting engine which can exert a pull but not a thrust and with regard to any class of engines, some of the most important questions which can be asked are What is (1) their efficiency, (2) their weight for unit of power, (3) how does the efficiency vary with the rapidity of the stroke (*i e* piston speed); (4) how do these quantities vary with absolute size? The physiologist may further inquire (5) What is the nature of the nervous stimulus and how does it effect the required longitudinal contraction and lateral dilation of the muscular fibres? Electricity will act as a stimulus, but (6) is it certain that nervous stimulus is of the same nature? (7) Does an excised muscle behave in the same way as the muscle in a living animal?

Striped muscle wherever met with—from mammal to insect—varies very little in appearance or in the cross-section of the individual fibres (8) Is the contractile force which can be exerted by each fibre the same or nearly the same in all orders?

These questions are not answered by any of the papers to which allusion has been made

In a letter which appeared in NATURE of April 15, 1920, I said: "When muscular force is exerted, power is expended and fatigue is produced, even when the muscle remains stationary Again, when no external force opposes the contraction of the muscle, physiological causes set a limit to the speed at which contraction can take place In both cases the whole power

expended is lost in so far as the production of useful work is concerned."[1] For the maximum nervous stimulus the acceleration is limited by the mass of the muscle itself and of those parts or limbs to which it is attached and which must move with it, and the greatest contractive force will act when the muscle is stationary, the whole of the power again being lost by muscular leakage. Between these limits there must be a "most economical speed," i.e. a speed which will develop the greatest useful power.

If it is assumed that the leakage is proportional to the tension of the muscle, and is the same for the same tension whether the muscle is stationary or in motion, and also that all the work done in internal acceleration is lost (assumptions which should be the subject of experiment), the most economical speed is that which makes the losses by leakage and acceleration equal. If the operation of the muscles is periodic and is associated, as for example in walking, with a natural gravitational period, part of the acceleration is done by gravity, and the muscles only supply as much as is required to convert the natural period to the period of the step—that is, to convert a free period T_1 into a forced period T_2.

A simple experiment which will show the difference between the power required to maintain the forced and free motions may be made as follows. Crossing the arms so that the wrists are in the same vertical plane, make each hand describe a circle about the line joining the elbows and note the rate of revolutions which can be sustained. Here there is no external work to be done, and, since the average position of the forearms is horizontal, the natural period is infinite. Various muscles, however, must act periodically to balance the centrifugal force. Next place both wrists in a looped strap which will form a wrapping connexion between the arms. This will not interfere with the orbital motion, but the centrifugal force will be taken wholly by the strap, and the forced period may in consequence be any imposed period.

With this arrangement it will be found on trial that for the same sense of fatigue the rate of revolution is more than double that which could be reached when the hands were free. The only work done when the strap is in use depends on the small tangential force required to overcome the viscous and leakage losses.

If there were any direct method of measuring fatigue, experiment on these lines would afford a quantitative measure of the relation between the power spent in leakage and in acceleration.

As regards the behaviour of isolated muscle, H. S. Gasser and A. V. Hill give an account (Proc. R.S., B, vol. 96, p. 398) of experiments on an excised muscle fixed at one end and at the other attached by a thread to a balanced beam the moment of inertia of which was adjustable. The muscle was stimulated by a brief current from an induction coil, and the movements of the beam were observed and recorded.

It is not stated whether the same muscle was used in all the experiments, but it may be gathered that each specimen, if there were more than one, was used many times.

It can scarcely be imagined that a muscle deprived of blood supply can continue to perform work, unless that work is supplied by the stimulating current, but the amount of the electrical work is not given. If, however, the work done by the muscle is merely the equivalent of that supplied by the coil, it would indicate that nervous and electrical stimulation differed in kind, for nervous stimulation seems to act much as an igniter does on a charge of powder, that is, to call up power inherent in the muscle.

It would be interesting to have these experiments repeated in a somewhat modified form. Instead of acting on a massive beam, let the muscle turn a wheel by a ratchet and pawl against a resistance controlled by a brake (these need not weigh more than two or three grams) and let the stimulus be applied periodically. Let an automatic record be provided for the stroke, the brake force, and the electric energy consumed in stimulation, and let the experiments be continued for con- 'erable periods (minutes or hours if necessary). In this way a comparison could be made between the work supplied and the work performed.

A. MALLOCK.

9 Baring Crescent, Exeter,
December 22.

[1] In this letter an analogy was suggested between muscular action and the working of an engine with a leaky cylinder. The supposed action would also be indicated if a cord, loaded with a certain mass, the motion of which was opposed by a viscous force, had one end attached to a wheel and brake, while the other was fitted with a hand-grip, which, when tension was applied, would slip at a speed proportional to the pull. Here the turning of the wheel would be a measure of the useful work done, and the slip, of the muscular leakage. If the applied tension was less than the brake resistance the cord would not move, but work would be done by the slip, and if the tension is greater, the mass will be accelerated until its viscous resistance plus the brake resistance is equal to the pull applied.

Constant Differential Growth-ratios and their Significance

ON Mr. Julian Huxley's very interesting results as to the fiddler-crab (NATURE, December 20, p. 895), I suggested at Cambridge that in his equation $y = bx^{1.61-1.64}$, if we are to rationalise the index, $y = bx^{\frac{5}{3}}$ comes nearer to his results than does $y = bx^{\frac{3}{2}}$, and allows of the conceivable physiological explanation that the ratio of claw-weight to body-weight is the isogonous ratio multiplied by a ratio proportional to a growing area in the body. Thus the weight of the claw might be the isogonous weight multiplied by the ratio of an isogonous surface secreting a male hormone to a surface secreting a female hormone and remaining of constant area. I also pointed out that in the roe of the plaice we have a sexual appendage, shed every year, and every successive year showing an increasing rate between its weight and the weight of the body. The parallel proves so astonishingly close that I ask space to communicate the following two facts:

(a) Representing the weight of the ripe roe of a plaice as y and the weight of the gutted body as x, then, in plaice of different weights

$$y = bx^k,$$

as Mr. Huxley discovered for the claw of the fiddler-crab. The ration of ovary-weight to body-weight has no relation to age, but only to body-weight; in this, as in some other respects, the age of a plaice is not measured by years but by the quantity of food which it has succeeded in assimilating.

(b) In the above equation, from the small sample of data at my disposal, I make

$$k = 1.58 \pm 0.10$$

$$-\log_{10} b = 2.610 + 3.063(k - 1.58).$$

This preliminary investigation has been on data which Dr. Wallace kindly gave me at Lowestoft in 1906 from his manuscript notes (9 fishes, gutted weight 429 to 1800 grams, age-groups IV. to XIV.) and some published by Fulton (vol. ix. p. 263; 5 fishes, weight 1280 to 2145 grams, age-groups VIII. to XVI.). They are insufficient to determine with certainty whether or not k varies with increasing weight; on the whole the most probable conclusion from the data is that k is constant. Since Dr. Wallace's figures include only two fish more than 1100 grams, and Fulton's smallest fish is 1190 grams, it is impossible to test directly the similarity of the two groups; but taking the centre of gravity of the logarithms for the ovary and body-weights of

the three fishes under 700 grams, the line joining this to the centre of the remaining 11 fishes gives $k=1\ 610$, while the line joining it to the centre of only the 6 larger Lowestoft fishes gives also $k=1\ 610$ The figure 1 58 has been adopted as giving for the fourteen fishes the lowest average error, 0 0512, in the resulting deduced log y, but the average error with $k=1\ 500$ is only 0 0553, and with $k=1\ 667$ is 0 0536, so that the $\pm 0\ 10$ seems to indicate the probable extent of our knowledge (With $k=1\ 75$ the average error is 0 0626, and with $k=1\ 25$ it is 0 0781 It must be remembered that logarithmic plotting imparts an illusory aspect of accuracy, errors of 0 051 and 0 078 in log y represent errors respectively of $11\frac{1}{4}$ per cent. and 20 per cent in the weight of the ovary) Further investigation of the extensive data by now available from the North Sea Investigations seems best left in the hands of those expert in the history of the statistics and in the natural history of the material It would be instructive to know whether the increase in ratio of ovary to body-weight means a disproportionately large number of ova, or an isogonous number of ova of increased size? If an "area" really determine the ratio, does it secrete, in plaice or in crab, a hormone promoting cell-division, or promoting cell-growth?

The most interesting question now is whether the fact that $k=1\ 6\pm 0\ 1$ in fiddler-crab's claw and plaice's ovary be a chance coincidence, or whether Mr Huxley's index, as well as his law of growth, be found to hold good in yet other animals?

I would urge that the latter suggestion cannot be negatived except by investigation of organisms living in the water. The index of the stag's antler would not necessarily follow the same law, for as a terrestrial animal the stag is under the necessity of a waning annual coefficient of bodily growth, since its size must not exceed the size which its legs are adapted to carry Plaice add approximately an equal weight every similar year, for though the size of an aquatic animal may be limited by the size of its food or of its enemy, it is not affected by conditions of mechanical support An average man is $5\frac{1}{2}$ feet high, but there is no average length for a plaice, the plaice which is ten times the age of sexual maturity will be a longer fish when she is eleven times that age

It seems possible that this necessity for a waning coefficient of growth may be the explanation of our death Our growth-rate wanes very slowly to the zero point at 27 years old, but it does not stop waning when zero is reached Except for creatures whose life is ended by the winter or summer, and those that perish with the act of reproduction, I do not remember any evidence of a marine animal dying a natural death, as we use the word of ourselves It is natural for every fish to have life ended by the fangs or jaws of his fellow-creatures, in the waters, is any other end natural? Did old age and death only become the necessary fate for plants and animals when they left the swamps, claimed the land, and attempted swiftness or tallness in a medium 1/800 of their specific gravity? If this be true, it was for proportionment of weight to transverse section that we were compelled to renounce the gift of eternal growth, and to accept death GEO P BIDDER

Cambridge, January 5

On the Efficiency of the Petersen Grab.

THE Petersen Grab is now being much used in various parts of the world for the purpose of picking up a portion of the sea-bottom—where this is soft enough—along with the animals of all kinds contained in the surface layer of that portion of the sea-bottom When a sufficiently large number of samples can be taken on a homogeneous stretch of ground the grab-samples are made a means of determining quantitatively the average distribution of the sedentary population of that area

In the earlier illustrations of the instrument, as used by Petersen, two types are shown One of these types appears to be in general use to-day, and is regarded by the present writer as inefficient, while the other, which appears to have gone out of use, is more efficient in principle, and by a slight alteration can be made reliable in practice

During a recent survey of the oyster beds in the Fal Estuary, the present writer employed the Petersen grab, but came to the conclusion that the current form of grab was inefficient for the determination of an oyster population, and further, that on grounds

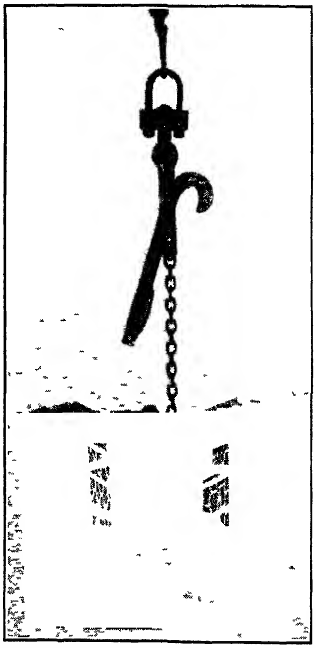

FIG 1—Peterson Grab modified to cut into a rectangular surface of the sea-bottom and to ensure partial protection of the gap present during closure (From a photo by Mr A J Smith)

in which the grab cannot dig, and probably also to some extent even on soft grounds in shallow water, the grab will not pick up with certainty the extent of surface of the sea-bottom which it is supposed to do The grab consists essentially of two very nearly quarter-sectors of a cylinder hinged along the axis of the cylinder When the instrument is closed it has the form of very nearly half a cylinder The occluding edges of the sectors are very nearly radii of the cylinder end section, and their peripheral ends are separated by a chord of about 36 cm in the open condition of the 1/10 sq metre type, in which the diameter of the imaginary cylinder is about 45 cm The occluding radii of the sectors of this type are only exposed in about 16 cm at their peripheral end, as a central small metal cylinder of about 12 cm in diameter is built into the instrument around the main axis The instrument is closed by a vertical pull on a chain, which passes over a pulley on the inside of one sector and is attached to the inside of the other (Fig 1) In use the instrument is allowed to run freely and arrive on the bottom with a bang, the check on arrival being utilised to release the chain used for closing and hauling

It follows from the construction of the grab that, in the act of closing, the gap in the semicircular ends tends to become higher and reach a maximum height of about 15 cm from the line joining the peripheral ends of the occluding sector radii This gap in the instruments at present in use is unprotected, and since the portion of the sea-bottom taken in the instrument cannot slide freely into the cavities of the sectors due to internal obstructions and friction, the captured soil tends to pile up under the middle of the instrument and opposite the gaping ends Consequently, there is grave danger of a portion of the surface with its contained animals becoming lost by being pushed out of the grab at the final closing strokes The loss of soil from this cause is no doubt greater on muddy grounds than on sandy ones, but has nevertheless to be reckoned with on all types of grounds

It follows, therefore, that quantitative estimates of animals in the sea-bottom made by using the type of grab described are in all probability too low In using the grab for quantitative estimations of oysters, the loss of a single oyster from approximately one square foot of ground is a very serious error, and the instrument was quickly altered to the type shown in Fig 1 by bolting thin steel plates to the sides of one sector, so that when the grab touched the bottom it actually cut into a rectangular piece of soil This modification is, however, still open to objection where animals living *in* the soil are being sought for, and the type of grab which will pick up a definite portion of the bottom soil with certainty is one the end plates of which form a complete semicircle In such an instrument the end plates would cut into the soil before the sector jaws reach it, and protect the gap during the whole of the closing operation

J H ORTON
Marine Biological Laboratory, Plymouth,
December 24

The Nature of the Contractile Vacuole.

FOR some years we have been investigating the cytoplasmic bodies in the protozoa In NATURE of March 10, 1923, we were able to give the first account of the stages undergone by the Golgi bodies in the sporozoon Adelea A full account of this work has been published in the *Q J M S.*, vol 67, Part III, 1923 More recently M Ph Joyet-Lavergne (*Comp rend*, 1924) has described the Golgi bodies in *Aggregata Eberthi*, and *Adelina dimidiata*, confirming our account

For some time our attention has been given to an examination of the Ciliophora and Rhizopoda, in which we have failed to discover anything which we can satisfactorily homologise with the Golgi apparatus of the metazoon

Now, however, Dimitry Nassonov, in the *Archiv f mikr Anat u Entwick*, Oct 1924, publishes a large paper in which he seeks to homologise the contractile vacuole of the protozoon with the Golgi apparatus of the metazoon

Nassonov, by means of osmic acid technique, has succeeded, as we have done in our material, in blackening the cortex of the contractile vacuole and the canals leading to it He claims that this osmiophile membrane has the property of secreting an osmotically active substance into the lumen of the contractile vacuole, and also itself has the distinctive character of a semipermeable membrane

Furthermore, Nassonov gives several reasons for homologising the Golgi apparatus of the metazoa with the contractile vacuole cortex of the protozoa — first, both organellæ are not visible *in vivo*, second, their morphology is similar, both being bladders with an osmiophile wall, third, the sponge (the metazoon nearest to the colonial protist) has a Golgi apparatus which looks like a contractile vacuole, and finally, the Golgi apparatus of the metazoan cell also has the power of secreting various substances

In the first place, Nassonov has shown that the cortex of the contractile vacuole has the power of reducing, and of becoming blackened by, osmium tetroxide We agree fully, having succeeded ourselves in blackening this cortex in a number of ciliates. We are also not unprepared to accept some of his interpretations as to the function of this lipoid membrane

When, however, we come to the homology of the metazoan Golgi apparatus and the protozoan contractile vacuole, we feel, at present, that there may be some grounds for doubt The Golgi bodies in embryonic or undifferentiated metazoan cells are almost invariably associated with a centrosphere and centrosome In the ciliates no relation between the contractile vacuole and any body similar to a centrosome can be demonstrated The centrosphere in metazoan cells is never, to our knowledge, a bladder-like structure, the sponge Golgi apparatus lies around a centrosome, from which the flagellum arises, and there is no evidence that the centrosphere in sponge cells is more fluid than the rest of the cytoplasm—but quite the reverse

The line of evidence that both the cortex of the contractile vacuole and of the Golgi apparatus are not visible *in vivo* need not detain us

Similarly, the view that the cortex of the contractile vacuole and the Golgi apparatus have similar powers of secreting substances, is not one of much value. The whole discussion comes down to the fact that the metazoan Golgi body, and the cortex of the contractile vacuole, both have the power of reducing osmium tetroxide There are a number of lipoid substances which share this power, and much attention should not be given to this faculty alone

Coming down from pure hypothesis to facts, what we know at present is this. a perfectly normal Golgi apparatus has been shown to exist in certain Sporozoa —in Adelea, Coccidium, Aggregata, Adelina, and Haplosporidium The methods used for this demonstration have not succeeded so far in revealing a similar structure in any ciliate, though the contractile vacuole cortex can be blackened by osmic acid In this laboratory we have tried amœbæ, and many ciliates both free living and parasitic, and we have come to the conclusion that a Golgi apparatus probably does not exist in the Ciliophora and Rhizopoda examined by us

Finally, we prefer to believe that the Golgi apparatus arose in some primitive flagellated organism in direct association with the blepharoplast

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The Interaction between Silica and Electrolytes in its Relation to Theories of Soil Acidity.

IN a note to NATURE (Dec 2, 1922) some experiments were described in support of a theoretical explanation advanced in an earlier paper (*Phil Mag*, vi 44, 338-45) regarding the nature of soil acidity. Joseph and Hancock (T 1923, 123, 2022), however, state that " pure silica produces no effect on a solution of an acid," and that the adsorption we reported " would not be observed if the silica were more highly purified " We have since repeated our experiments

with hydrated silica (obtained in three different ways), which was purified with the greatest care. We have been able to confirm our previous observations that hydrated silica adsorbs acids and that electro-osmotic experiments show that anions are preferentially adsorbed, but we have also found that the samples of silica we used before contained alkali, and gave a much higher value for the amount of acid adsorbed. The adsorption of oxalic acid can be very easily demonstrated in view of the simplicity with which it can be volumetrically estimated. 10 gm. of air-dried hydrated silica obtained from the hydrolysis of pure silicon tetrachloride can retain, even after repeated washings, oxalic acid equivalent to 10 c.c. of N/100 permanganate solution.

It has been suggested by the writer (Trans. Far. Soc., vol. 18, part 3, p. 316) that the increase in P_H of the drainage water from Dartmoor may be attributed to the adsorption of acids by the siliceous beds over which the water passes. It is quite easy to demonstrate in the laboratory that a solution of hydrochloric acid, after filtration through a Gooch crucible of fused silica containing air-dried hydrated silica (from silicon tetrachloride), immediately shows an increase in P_H, amounting to more than one unit, indicating a diminution in concentration of more than 90 per cent. (*e.g.* from 3·4 to 4.6).

It has also been stated by Joseph and Hancock that interaction between silica and salt solution is of a chemical nature, as the residue gives an alkaline reaction on removal of the salt. It appears to us that this is not the only possible way of accounting for the production of the alkali (cf. "Adsorption by Sugar Charcoal," Bartell and Miller, J. Amer. Chem. Soc., 44, 1922, 1866; 45, 1923, 1106; 46, 1923, 1130).

Attention may be directed to the fact that the concentration of the acid liberated by a potassium chloride solution of definite concentration depends on the relative amounts of silica and solution, as also on its previous history. It would appear from the observations of Joseph and Hancock (*loc. cit.* p. 2023) that whereas a sample which has been previously treated with hydrochloric acid gives an extract having a P_H value equal to 3.96, samples which have not been treated with acids give extracts having P_H value equal to 5.33 (or 5·55) under identical conditions. The variation in concentration of the hydrogen ions of more than twenty times is extremely difficult to explain in terms of a chemical reaction. We would also like to mention the observations of Jordis and Kanter (*Z. anorg. Chem.*, 35, 20, 1903), who, from the difficulty in removing the last traces of hydrochloric acid from silica, concluded that silica forms traces of a complex acid similar to hydrofluosilicic acid.

Further experiments with precipitates like barium sulphate show perfect analogy with the reactions we have observed with silicic acid. In these instances, possibility of a chemical interaction between an acid and a neutral salt is very remote. In this connexion an interesting observation may be recorded, which to the writer's knowledge has not been recorded before. If barium sulphate is precipitated from the interaction of solutions of potassium sulphate (P_H = 6.8) and barium chloride (P_H = 6.6), the liquid shows either an alkaline or an acid reaction according as potassium sulphate or barium chloride is in excess. The acidity or alkalinity may be as high as that indicated by P_H values of 2 and 11 respectively. This reaction appears to offer a clue to the elucidation of the nature of "hydrolytic" adsorption.

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Calcutta, India, November 27.

Helium and Airships.

IN a recent article on the British dirigible programme (NATURE, December 6, p. 842) it is stated "The United States naturally hold for themselves the only supplies of helium." Of course, it must be admitted that the United States authorities, ever since 1918, have pressed with vigour the investigation of their resources of helium, its production and use. At the present time the two large dirigibles, the *Shenandoah* and the *Los Angeles*, are inflated with helium. Processes of repurifying the gas in them have been devised and applied. A more efficient and cheaper method of production than the present Linde process has been worked out by the U.S. Bureau of Mines, and much valuable scientific data have been accumulated.

It should not be forgotten, however, that Prof. J. C. McLennan's investigation in 1916–1918 (see NATURE, August 12, 1920, p. 747) showed that helium could also be produced in Canada, and an experimental extraction plant was successfully operated in Calgary, Alberta, for a few months until financial support was no longer forthcoming. Since that time, the Canadian Department of Mines, in the course of a general investigation of natural gas in Canada, has confirmed and brought up-to-date the facts concerning the helium resources of Canada. Although few gases have been found with so high a helium content as the richest American natural gases, it is believed that commercial sources are available. To prove this, the re-establishment of an experimental helium extraction plant in Canada is essential. In this plant the best process for treating the different types of Canadian natural gas could be determined, and the actual cost of commercial production could be found. The helium produced, until such time as it was required by the authorities, would be of great value to supply to the many university and industrial research laboratories throughout the Empire which are needing it for experimental purpose.

In connexion with a later paragraph of the same article, referring to the useful life of German airships and the interest with which the progress of the *Los Angeles* (ZR3) and the new British craft will be observed, no reference is made to the great success already obtained with the helium-filled *Shenandoah*, which has now been in commission since the summer of 1923. In this period it has made many long voyages, including one transcontinental trip of more than 9000 miles. Although torn from its mooring mast with the framework damaged and two gas bags ripped, during a severe storm in January 1924, it eventually returned to its hangar. A hydrogen-filled ship subjected to the same conditions would probably have been destroyed.

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Molecular Dimensions of Celluloid.

MAY I amplify and comment upon Mr. Garnett's letter in NATURE of January 10, page 51? I have often been impressed, more particularly during the last few months in collecting material for a small book on cellulose ester solutions, with the want of precision shown by physicists in defining the material used in experiments on nitrocellulose and its technical derivatives. Two eminent examples will suffice. My friend Prof. Coker entitled a most important paper, which he published in collaboration with Mr. Chakko, "The Stress-Strain Properties of Nitrocellulose and the Law of its Optical Behaviour,"

whereas the material on which his experiments were carried out was xylonite or celluloid containing at least a fifth of its weight of camphor and rather more than that proportion of camphor by volume (Phil Trans, A, vol 221, pp 139-162) Another old friend and teacher, Prof Filon, in a paper which he and Mr Jessop published on the stress-optical effect in transparent solids strained beyond the elastic limit (Phil Trans, A, vol 223, pp 89-125), after deducing the existence in xylonite of a mixture of two materials with different elastic and plastic properties (page 112), speaks in his summary (paragraph (2), page 123) of "nitrocellulose under simple tension" The distinction between xylonite and nitrocellulose in this relation is really important, as it is probable that the elastic and stress-optical properties of nitrocellulose alone would be markedly different from those of xylonite

Mr Garnett refers to celluloid as the basis of photographic film This is true, but photographic film is quite different in its composition from celluloid in the more massive form, such, for example, as was used by Prof Coker and Prof Filon Not only is the nitrocellulose in celluloid film more highly nitrated, but the proportion of camphor is smaller Even celluloid film, however, does not contain nitrocellulose so highly nitrated as to correspond with what used to be called cellulose trinitrate This would contain 14 1 per cent of nitrogen, while the nitrocellulose in cinema film usually contains from 12 0 to 12·5 per cent of nitrogen. Lastly, having supervised the manufacture of a certain amount of a substitute for celloidin during the War, I should naturally agree that it is a carefully purified product, but I should not like to say that it approaches to a single chemical substance

The analysis of celluloid, provided the camphor used in its manufacture is optically active, is not exceedingly difficult and can be carried out with moderate accuracy, and it would add greatly to the ultimate value of physical measurements made with the material if its composition were always given In the instance which forms the subject of Mr Garnett's criticism, one would like to know not only the chemical characteristics of the nitrocellulose used, but also as many physical properties as possible, more especially perhaps the fluidity-concentration curve in two or more chosen solvents. It is greatly to be desired that all researches on colloid materials should seek to correlate at least two different properties

FOSTER SPROXTON

The British Xylonite Company, Limited,
Brantham Works, near Manningtree,
Essex, January 13

The Need for a Universal Language.

I READ President Coolidge's address and Prof Gardner's letter on this subject in the *Times* of November 21, 1923, and, now, your report of Prof R G Kent's article (NATURE, January 3, p 23), with interest, but there are two points connected with the matter to which attention may usefully be directed. One of the principal causes of the neglect of Latin and Greek in schools is the world-wide recognition of the importance of a knowledge of the so-called "modern languages" This is a blind argument It is as if a student, desiring to acquaint himself with the contents of the top shelves in a library, deliberately ignored and neglected the ladder by which they are reached, and tried to get at them by jumping Those who are old enough to have been at school in the days of compulsory Latin and Greek amply realise the enormous value of even an almost forgotten grounding in the classics, in the acquisition of any foreign language—this point requires no labouring. I wish to point out the great value of having at some time been taught the phonation of an unfamiliar text, like Greek, when one comes in later life to study any Oriental language—or, for obvious reasons, Russian. The mind is no longer terrified by the aspect of unknown characters, and thus the first great, and often repellent, difficulty is recognised as being really of little account

A still more important point arises in connexion with the periodically recurring agitation for a "Universal Language" The obvious fallacy of founding such "languages" as Volapuk, Esperanto, Ido, and the others upon the native language of their protagonists requires no argument The result is that each country pleads for its own universal (?) language, and we are back again where we started from

But Latin is, and always has been, *the* universal language Its claims are fully set forth in the report of the Committee of the British Association (1921, p. 390) I cannot, however, agree with the "Conclusion" of the Committee Down to, and even in, modern times, knowledge intended to be of world-wide distribution has been, and is, conveyed in Latin —and the worse the Latin is, the easier it is to understand I am not one of those who plead the rarefied joy of reading the great Latin authors in the original tongue—we have not the time, and existing translations are amply satisfactory—but we do want a language of universal intercommunication, and the appalling Latin of the Roman Church (cf. the Bollandists' "Lives of the Saints") is entirely sufficient for the purpose I have proved this in many obscure corners of the world, using a doctor, chemist, priest, or librarian—any one in a black coat, in fact—as an interpreter

If this were once realised and recognised, I see no reason why within a short time one may not ask of any wayfarer in a Magyar town

"Quae est via ad vapor-stationem?"

And receive the reply "Primus ad dextram et tunc tertius ad sinistram"

Atque Felix semper ambulabat.

(O, Shade of Arnold !)

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Balfour Stewart's Advances in Radiation Theory.

THE extremely interesting notes by Sir Arthur Schuster in a recent number of NATURE (January 17, p 87) may possibly leave with the ordinary reader an impression that Balfour Stewart's contributions to the establishment of the laws of natural radiation were slighter than was actually the case The considered opinion of the late Lord Rayleigh, set out in *Phil Mag*, 1 1901, pp 98-100, or "Scientific Papers," iv pp 404-5, can hardly be gainsaid In Stewart's discussion of radiation in an isolated enclosure containing moving bodies, his expressed conviction, that the second law of thermodynamics is only satisfied through the action of mechanical forces necessary to maintain the motion, is only turning round the other way the considerations employed by Boltzmann and by Wien long after, who by means of these mechanical forces (namely, the reaction of radiation pressure) combined with the second law of thermodynamics, deduced the law of structure of natural radiation Reference may also be made to footnotes appended to the reprint of Stokes's cognate papers in "Math and Phys. Papers," iv especially p. 136

JOSEPH LARMOR.

Cambridge, January 16.

The Tsetse-Fly Menace in Tropical Africa.

By Major A. G. Church, D.S.O., M.C.
(Member of the East African Parliamentary Commission).

THE inauguration of a campaign against the tsetse-fly in Tropical Africa is long overdue. Tropical Africa is becoming progressively important as a source of food-supply and raw materials for the Eurasian and American nations. The world at large, therefore, cannot contemplate with equanimity the domination by "fly" of a large proportion of the most fertile lands in the tropics. What is most disquieting, moreover, is the fact that the area under "fly" is increasing and not diminishing. Hitherto, no colonial government has either had the means or has considered it worth while to adopt methods for its extermination like those employed by Gorgas in the Panama Canal zone against the mosquito. Yet, in effect, the ravages due to glossinæ are, in some respects, more deadly than those due to anophelines. Malaria has been largely robbed of its former terrors. It can be prevented and cured. But up to the present no certain preventive remedy has been found for human sleeping-sickness and animal trypanosomiasis, although cases of sleeping-sickness have been cured by atoxyl, Bayer "205," or tryparsamide.

From reports supplied to the Parliamentary Commission by the scientific staffs of the five East African territories, Northern Rhodesia, Nyasaland, Tanganyika, Uganda, and Kenya, it appears that the fly-belts are continuous from the Egyptian Sudan to Southern Rhodesia. Two-thirds of Tanganyika are under "fly," and this area is increasing owing to the encroachments by fly over the contiguous cultivated areas. Fly areas which a few years ago were confined to the north-eastern district of Northern Rhodesia now extend as belts through Nyasaland to the lake and make the southern and northern movement by land of cattle from the important district of Mombera an impossibility. Most of the islands on Lake Victoria Nyanza are depopulated, some compulsorily as in the case of the Sese[1] islands, others voluntarily, owing to the ravages of sleeping-sickness.

The members of the Parliamentary Commission, on their journey from Dar-es-Salaam along the central Tanganyika Railway, were struck by the desolation of a long stretch of country between Kazi-Kazi and Tabora, a country which was formerly thickly populated. Along the eighty miles of road from Tabora to Kahama men and women passed in procession carrying head-loads of ground nuts to Tabora market, primarily due, not to the conservatism of the native, but to the impossibility of using ox-wagons in a fly district. The following day they passed along thirty miles of road approaching Shinyanga without seeing a native or a head of cattle, although the route lay through a district of exceptional fertility. Half the journey from Shinyanga to Mwanza provided the same melancholy testimony of the disastrous effect of tsetse. In one sultanate in this district the population has gone down from thirty thousand to three thousand in the past few years, due entirely to the destruction of cattle by this insect pest. For the natives, who still measure their wealth by the number of cattle they possess, will not remain in a district where the cattle die. Mr. Swynnerton, Chief Game Ranger to Tanganyika Territory, states that the fly is known to have advanced in seven places in one district during the past year. The largest cattle area in Tanganyika Territory is threatened by the advance of *Glossina swynnertoni*.

It is, however, not merely the destruction of cattle, but the effects which such destruction has upon the natives themselves and the country, which are now causing the gravest concern to the authorities. Major G. St. J. Orde Brown, an administrative officer with years of experience, attributes to this agency the degeneracy and degradation of the north-eastern branch of the Yao tribe compared with the main tribe. The loss of their cattle has led to the breakdown of tribal customs and the decline in their morality. There is another serious factor which must be taken into account. The lines of communication for the greater part of East Africa must necessarily pass through fly areas. For some years at least the economic products must be carried over roads. At the present time most of the roads are unfit for motor transport. The use of ox-wagons becomes, therefore, a matter of first importance, but at present their use is circumscribed by the fly-belt. In the past two or three years there has been a remarkable increase in the productivity of the native in most parts of East Africa. If this is to be maintained, the districts through which the roads pass must be cleared of fly, for the present method of head porterage is totally inadequate, and traders are already complaining that their up-country stores are filled to overflowing.

It must not be imagined that this problem has not been viewed with the gravest concern by medical and veterinary officers on the spot, or that the home authorities are not aware of the menace of the tsetse-fly. The work of Sir David Bruce is well known. So long ago as 1902 the Royal Society sent out a commission to investigate trypanosomiasis. Much individual and team work of great importance has been done since then. In 1914, Dr. J. O. Shircore, in a contribution to the *Bulletin of Entomological Research*, formulated a plan for the extermination and control of fly. He showed that the primary fly centres were to be found where moisture and game persisted throughout the year. They were to be found, in other words, where light forest, short grass, open glades, and water existed. Furthermore, from these primary centres the fly extended to secondary centres, and bush cover was essential as a communicating link between primary and secondary centres. He suggested that the secondary centres must first be attacked by cutting off their bush connexions with the primary centres, and that when the primaries had been isolated, wholesale and extensive burning during the dry season should be undertaken on a heroic scale. Unfortunately, the War intervened, and it was not until recently that Mr. Swynnerton's energies were applied to the methods suggested by Dr. Shircore. But Mr. Swynnerton has gone further. There is no ques-

[1] The natives are now being encouraged to return to these islands.

tion about the dependence of the fly upon blood The further assumption was made that the fly cannot exist without game Mr Swynnerton has shown this to be untrue In the Dar-es-Salaam district there is no game, but there are three kinds of fly known to exist The fly apparently feeds upon human beings and animals indiscriminately

Mr Swynnerton proposes to exterminate the fly by bush burning, and he has already achieved a considerable measure of success in the Shinyanga district There he was fortunate in obtaining the collaboration of a native chief of character and understanding and energy Makweia, the chief in question, once convinced of the importance of fly extermination, called his people together and informed them that they were to take part in a campaign against a more insidious enemy than man, that they must discipline themselves and respond to instructions as if they were engaged in tribal warfare With the assistance of fifteen thousand natives, Mr Swynnerton was able to undertake bush clearings by means of burning and cutting on a vast scale, with the result that a large area of country will this year be under cultivation and a hitherto desolated district be re-populated and re-stocked.

In the neighbouring province of Uganda, Drs Carpenter and Duke, and Mr Fiske, are carrying out research of the greatest importance Only a few years ago, owing to the death of more than two hundred thousand natives of sleeping-sickness, Sir Hesketh Bell removed the remaining population from the lake islands and the lake shores, an extremely costly undertaking and one which has been responsible since for much unrest among the detribalised natives Mr Fiske is carrying out single-handed an entomological survey of Uganda. Dr Duke is at the moment engaged upon the important task of classifying human and animal trypanosomes and the connexion between human and animal trypanosomiasis Dr Lamborn, who has been working in Nyasaland, has for some time been engaged in the task of breeding parasites which attack the tsetse-fly with the object of exterminating tsetse by this measure

It is clear, however, that unless all these territories make a co-ordinated and combined effort to deal with the tsetse-fly menace, the achievements in one territory will be negatived by the indifference in others It will be useless, for example, to exterminate the fly in Uganda and Tanganyika portions of the Lake territory, if Kenya undertakes no similar campaign in the Kavirondo district Sir Robert Coryndon, Governor of Kenya, has stated that "the leading experts who deal with the problems of sleeping-sickness and tsetse-fly control are servants of Uganda, and there is little organised or encouraged co-ordination or exchange of views between them and their technical colleagues in Kenya and Tanganyika Territory" In Kenya colony, as a matter of fact, there is practically no staff available for work in connexion with sleeping-sickness or animal trypanosomiasis

There is every indication, however, of a changed attitude In every territory the Governors impressed upon the members of the Parliamentary Commission the necessity for a co-ordinated plan of campaign in the interests of their territories At the present time the Imperial Bureau of Entomology is engaged in formulating a plan of campaign of research into tsetse-fly problems. It is quite obvious that the problems are so vast as to be beyond the capacity of less than ten men to deal with them As Dr Andrew Balfour said in an address at the Anderson College of Medicine on October 14, 1924: "We are not yet certain as to whether *Trypanosoma gambiense* and *T rhodesiense* are the same parasite or different species We still quarrel over the vexed question of the big game, or perhaps one should say the wild animals, as reservoirs of infection We know precious little about immunity to the disease, we are not at all sure as to the habits of Glossinæ, and we are still trying to discover which is the best drug and how we can best prevent this mysterious complaint" The matter is one of such great importance that it is to be hoped that Major Ormsby-Gore's suggestion, that a large working commission of experts be appointed to undertake the necessary research work in consultation with the men on the spot, will be acted upon Such collaboration must form the basis of any heroic measures for tsetse-fly extermination

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F R S

5 LUDWIG BOLTZMANN (1844–1906)

I DID not know Boltzmann intimately, but can tell of some incidents in his life and quote from passages in little-known publications, which mark his impulsive and vigorous character, and illustrate some features of his personality that would be missed by any one acquainted only with his scientific writings As a young man twenty-six years old, who had only published one or two minor papers, Boltzmann called on Konigsberger, then professor of mathematics at Heidelberg, mentioning incidentally that he had discovered an error in one of Kirchhoff's mathematical papers Konigsberger told him that this was a good opportunity of becoming personally acquainted with one of the great men of the time "Call on Kirchhoff," he advised. "Lead the conversation to the subject, and explain the nature of his error"

Boltzmann acted with characteristic impetuosity. Within an hour Kirchhoff, who always took a great pride in his accuracy, came rushing into Konigsberger's room in a state of extreme agitation. "A most distressing thing has just happened to me," he exclaimed. "A young man, of whom I know nothing, enters my room, and before he has time to shut the door behind him, calls out 'Herr Professor, Sie haben einen Fehler gemacht!'" I give the tale on Konigsberger's authority

Boltzmann made his reputation during sixteen quiet years at Gratz, but it was a grief to him that his lectures did not attract a more numerous audience, and he was always looking out for a university where

[1] Continued from p 127

budding mathematicians were as plentiful as chemists or lawyers. He went to Munich; next to Vienna, but still not being able to satisfy his ambition he was drawn again to Germany, the country towards which he had strong political leanings. He received an offer of a professorship at Berlin, and I was informed by one in a position to know, that the faculty of science at that University received a series of telegrams and letters, few of the latter being dated, some accepting, some refusing, and no one knew in what order they were dispatched. Ultimately, the negotiations were broken off, and Boltzmann went to Leipzig, but he soon longed to return to Vienna That University would have welcomed his return, but the Emperor declined to call him back, on the ground that an Austrian subject who had accepted foreign service was disqualified from ever again finding employment in his dominion. Mr von Hartel—who at the time was Austrian Minister of Public Instruction—told me how for a considerable time he stood helpless between two fires: on one side the insistence of the University which wanted Boltzmann, on the other the obstinacy of the Emperor who remained firm in his refusal. At last von Hartel decided to make a final effort, and asked the Emperor for permission to put a hypothetical question. This being granted, the question put was: "If your Majesty's favourite ballet dancer were to run away, and after a year's absence wanted to return, would you have her back?" The Emperor admitted that perhaps he might.

"I beg to submit," said the Minister, "Boltzmann is to the University what your favourite ballet dancer is to you"

Francis Joseph laughed and gave in

I do not tell the story merely as an amusing episode, but because the image of Boltzmann's ungainly figure trying to practise ballet steps recalls to my mind the occasions—fortunately rare—when Boltzmann indulged in humorous writing. He had travelled much, visiting America, Constantinople, Athens, Smyrna, and Algiers, and in one of his writings tells us how he had always declined to publish an account of his experiences, but that after returning from a lecturing engagement at the Berkeley University in California, the temptation proved too strong, and an article appeared under the title of "Reise eines deutschen Professors in Eldorado." His jokes are driven into us with hammers Eating and drinking, followed by drinking without eating, form a favourite subject, because to him—as he says—the most important consideration in travelling is to keep one's digestion right. But he might have spared us the gross and unrepeatable allusions to the poisonous effects of pure water and the boast that his otherwise good memory for figures fails when he tries to remember the number of glasses of beer he has imbibed! The astonishing part of his recital is, however, its want of accuracy In an account of a dinner party given in his honour at the country seat of a wealthy lady near San Francisco, he tells us how it began with blackberries, which were followed by oatmeal: "an indescribable mixture of paste and oats, which might be used for fattening geese in Vienna were it not that the geese would refuse to eat it." The enumeration of subsequent dishes makes it clear that it was really dinner and not breakfast that was meant. On scientific matters also he falls into error, as when he tells the reader that the moons of Mars were discovered at the Lick Observatory

In great contrast with this heavy and vulgar joking, the other matter contained in the volume of popular writings shows us Boltzmann as a highly cultivated man, enthusiastic about poetry, fond of music, not averse from expressing an opinion on art, and with a leaning towards metaphysical speculations. An article on flying written in 1894 is specially interesting, and the following passage shows considerable foresight:

> "It is scarcely doubtful that a dirigible air-ship would create an expansion of intercommunication compared with which that due to the introduction of railways and steamers is negligible Our armies of to-day would be as helpless against the dynamite thrown down from flying machines as those of Rome would have been against breechloaders The customs' regulations would either have to submit to unthought-of alterations or to be abolished altogether."

Astonishing, as coming from an Austrian, is the German chauvinism to which Boltzmann occasionally gives expression. It appears in his article on aviation, and in a passage in the description of his Californian journey After criticising the Berlin Academy and expressing regret that, since the death of Helmholtz and other distinguished Germans, American students prefer to study in Cambridge and Paris rather than in Berlin, he adds that the United States, and with it the whole world, will suffer in consequence

On scientific matters his judgment is nearly always fair and uninfluenced by national feeling; at any rate so far as Great Britain is concerned Here is an example of his style of writing when he is carried away by his subject

> "A mathematician will at once recognise the authorship of the writings of Cauchy, Gauss, Jacobi or Helmholtz, just as musicians will distinguish between Mozart, Beethoven and Schubert on listening to the first few notes of a composition. Perfect elegance of construction, though occasionally supported by weak foundations, belongs to the French; the greatest dramatic vigour to the English—and above all to Maxwell Who does not know his dynamical theory of gases? First the variations of velocities are deployed in majestic array, next enter from one side the mathematical conditions and from the other the equations of central motion. Higher and higher rises the chaotic flood of formulæ until suddenly four words resound: 'Let *n* be 5,' and the malignant demon *V* vanishes, just as in an orchestra a wild overpowering bass may suddenly be reduced to silence By a magic wand, an apparently hopeless confusion is reduced to order. There is no time to explain why one or the other substitution is made; let him who does not feel it in his bones put away the book Maxwell is not a conventional musician who has got to explain his notes, obediently his formulæ deliver torrential showers of results, until we reach the final surprise effect. The problem of the thermal equilibrium of a heavy gas is solved, and the curtain falls. I recollect Kirchhoff's

remark to me. 'This is the way to deal with gas theories!'"

It is not perhaps fair to examine this passage too closely, as a certain amount of poetic license must be forgiven—but Maxwell did not write, "Let *n* be 5", he wrote, "It will be shown that we have reasons from experiment to believe that $n=5$." Sixteen words instead of four, but scientific accuracy has no chance when rhetorical effect is in danger, as the late Lord Rayleigh remarked to me when I criticised a statement of a distinguished relative of his.

Shortly after his final return to Vienna, Boltzmann committed suicide. With him passed away a man of great intellectual power and a fascinating personality. His predilection for Schiller's poetry indicates a strain of morbid sentimentality, and if his humour was somewhat primitive and his technique crude, he paid dearly for his disappointments in life

The Talking Film.

By Dr E. E FOURNIER D'ALBE.

THE demonstration of the De Forest phonofilm at the Royal Society of Arts on November 26, 1924, and its recent exhibition at the Royal College of Science during the Physical and Optical Societies' Exhibition, showed that the old problem of producing a motion picture endowed with its original sound effects has been brought within hail of a perfect solution.

As Mr C. F. Elwell remarked in the course of the demonstrations, the De Forest phonofilm was preceded by many partial solutions of the same problem.

The first "talking picture" was known as the "cameraphone"—the method employed being to make the motion picture while a stock wax cylinder type of record was played. The actors sang, or pretended to sing, and the camera photographed the lip motion The novelty of this method made it popular for a time

The "kinetophone" of Thomas A Edison was the next step in advance Better results were obtained for the reason that the phonograph record was made simultaneously with the making of the motion picture negative. The synchronisation of the sounds with the lip motion was good, but the reproduction of this synchronisation was difficult, as so much depended upon the skill of the operator, who generally had another man to start the phonograph record If mechanical or electrical means were supplied it was difficult to keep the phonograph record and the film exactly in step. If a portion of the film became mutilated the difficulties became greater. Notwithstanding these objections the "kinetophone" enjoyed quite a large measure of popularity. But this popularity waned, and finally no more was heard of this method

It became evident that no solution would be practically workable until a perfect synchronism between sound and movement could be automatically established It was, therefore, necessary to look for other methods of reproducing sound Among these the most promising was Ernst Ruhmer's "photographophone" of 1907, in which a "speaking arc" projected light through a slit on to a moving photographic film The audio-frequency fluctuations of the arc were thus recorded as a series of lines stretching across the film in a direction normal to its displacement, and Ruhmer succeeded in reproducing the original sound by transmitting a beam of light through this record to a selenium cell.

It was a modification of this method which Dr. Lee de Forest used for his talking motion picture. In common with Berglund and other experimenters, he confined the photographophone record to a narrow portion of the standard one-inch film as used in cinema theatres But his method of producing the record has many original features He uses a double-button ("push-pull") microphone with a duralumin diaphragm between the two buttons. Such a microphone is capable of carrying 20 milliamperes. It is placed

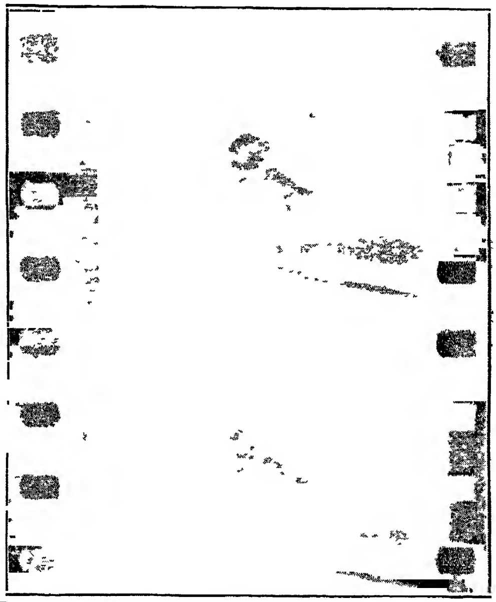

FIG 1—Enlarged photo of piece of film showing a banjoist performing The cloudy strip at the left of the photograph is the music record

about 5 feet from the speaker, and responds to all frequencies from 30 to 7000 per second

An even better device is a condenser microphone with a capacity of 4 milli-microfarads, which is found capable of a range of 25 to 8000 vibrations per second.

The distortionless amplification of the electrical pulses yielded by the microphone is nowadays a comparatively easy matter, thanks largely to Dr. Lee de Forest's own previous inventions.

The next stage is the conversion of the electric pulses into fluctuations of actinic light This conversion is neatly accomplished by means of a vacuum tube in which an electrode covered with barium dioxide discharges a current of some 5 milliamperes under a pressure of 150 volts through helium at 100 mm. pressure This vacuum tube is called a "photion" It responds instantaneously to the variations of the

amplified microphone current, and as its glow is of a highly actinic wave-length it produces a well-marked effect upon the film, upon which it shines through a fine slit

It remains to reconvert the photographic record into sound. For this purpose Dr de Forest prefers to use photo-electric cells instead of selenium, mainly on account of their more constant zero, though it is difficult to see why that should be of any consequence in the case of intermittent light Of the various forms of photo-electric cells he prefers T. W. Case's "thalofide" (thallium oxy-sulphide) cell, which has a resistance of from 5 to 500 megohms, and works best with some 140 volts on the electrodes.

The moving film passes a fine slit, 0 038 mm wide and 2·3 mm. long, illuminated by a small incandescent lamp The electric fluctuations produced in the circuit of the photo-electric cell are excessively minute on account of its high resistance, but four or five stages of amplification suffice to enable them to operate a loud-speaker, and the actual volume of sound heard at the demonstrations showed that not much difficulty need be anticipated on that score The remaining difficulty appears to be the distortion introduced by the loud-speaker Whether that can be entirely eliminated remains to be seen The rapid progress made in the construction of loud-speaking telephone receivers in recent times gives room for optimism in this direction In the banjo solo (see Fig 1) no distortion was perceptible, but President Coolidge's speech was marked by an exaggerated American accent, most of which must have been due to the manner of reproduction This fact may obtrude itself less upon an American audience than upon Britishers, but if it were to be perpetuated, the vogue of the American film in England would be seriously jeopardised

It has often been objected that nobody wants the talking film, that silent film acting is an art in itself, that the film has an international appeal, which would be lost by introducing speech and local accent, and that the art and training of even the greatest film "stars" would become useless if the film were to throw off its mantle of silence But the most probable issue is that the talking film will develop its own art and its own industry in its own way, and although it will no doubt evolve its own conventions and limitations, it is likely to win a permanent place among the amenities of civilisation

Obituary.

Abbé Rousselot.

The Abbé Rousselot passed away on December 16 last Born in 1846 at St. Cloud (Charente), he was ordained in 1870 and became one of the teachers in the Petit Séminaire de Richemont Leaving his pastoral work on account of his health, he devoted himself to language studies under Brachet, Bréal, and Bailly He became convinced that "phonetics should take as its basis not dead texts but the living and speaking man." In his peregrinations from parish to parish he became keenly observant of the fact that "sounds change with perfect regularity from one region to another", he came to believe that "phonetics could be something more and better than a descriptive science of spoken sounds, that it ought to be geographical" Noticing the differences in pronunciation among three generations of his own family living together, he got the idea of genealogical phonetics This thought led to the foundation of the science of experimental phonetics

Coming to Paris in 1880, Rousselot was initiated into questions of Romance linguistics by Gaston Paris and Michel Bréal, to the physical sciences by Branley and Becquerel, to physiology by Déjerine, and to fine instrument work by Koenig Finding it impossible to detect the finer details of spoken sounds by the ear, he complained to Gaston Paris, who said, "Only mechanical registration will give you accurate knowledge Attempts have been made in Marey's laboratory Go and see!"

In 1886, Rousselot devised an electric speech recorder with which he made investigations of his native dialect In 1889 the first course in experimental phonetics was given at the Institut Catholique de Paris In 1891 he obtained his Doctorat ès Lettres before a committee hostile to experiments—the first doctorate in experimental phonetics He was the inspirer of *La Parole* and later the founder and editor of the *Revue de Phonétique* (1911–1915) His great work, "Principes de phonétique expérimentale," was finished in 1908

In 1897, G Paris and Bréal succeeded in founding a laboratory of experimental phonetics at the Collège de France, it was annexed to the chair of comparative grammar (Bréal) and Rousselot was made its director In opening the laboratory, Prof Bréal did not hesitate to declare that "the moment has arrived when one could no longer think of phonetics as anything else than experimental", he proclaimed that from now onward "it would be necessary to collect facts instead of announcing *a priori* principles"

In this heroic age, the Abbé and his pupils worked with insatiable ardour at inventing apparatus, developing methods, and collecting facts They had to face the opposition of the whole world of linguists, grammarians, and philologists, but with ready pens they fired their bombs of explosive facts at the army of opinion and guesswork

Rousselot had several admirers and friends of the older generation outside France Foremost among them was the linguist and phonetician, Vietor of Marburg, who invited Rousselot to lecture there and insisted on introducing experimental methods in a modest way Under his auspices a phonetic cabinet was established with Calzia, a pupil of Rousselot, as chief. The speech pathologist Gutzmann developed an extensive laboratory on Rousselot's lines in Berlin in connexion with the speech clinic Coming into phonetics from another side, I had the privilege of spending a few weeks in Rousselot's laboratory in the early days; his spirit and his methods have been the inspiration in all I have attempted since

Few of Rousselot's pupils have succeeded in following him The environment has usually not been favourable, and they have seldom had the inspiration that

leads to self-sacrifice for an ideal The most successful pupil is probably Prof Calzia in Hamburg, who, in a favourable environment created by Meinhoff, has built up the most completely equipped laboratory of the present day A favourite pupil, Prof Chlumski, has now a laboratory in the University of Prag. His latest pupil and assistant, the Abbé Millet, has been appointed to take charge of Rousselot's laboratory

In establishing experimental or laboratory-phonetics, Rousselot's scientific influence has been decisive In France, laboratory work has been begun at Grenoble and Montpellier. Work with Rousselot's methods has also been introduced into the Sorbonne. In Germany, the large laboratory at Hamburg and the pathological speech laboratory at Berlin are based on his methods, smaller beginnings are found in other universities. In the United States I built up an extensive laboratory at Yale University, but the work was dropped after my departure The demand for this work in that country is now pressing, but no men can be found who have learned the methods In England I have for twelve years conducted researches on speech in nervous diseases, using Rousselot's graphic method, and I scarcely need say that in Vienna the work is based on Rousselot's ideas and methods

In one way it might be said that Rousselot just lived to see the realisation of his ideal as expressed by Prof Bréal The adjective "experimental" need no longer be used; there is no other kind of phonetic science This means that in investigating living speech, all judgments by the ear become quite subordinate to the study of registrations But no one could for a moment think of any antagonism between the phonetics of present-day speech and the science of historical phonetics treating of sound change in the past In fact, what experimental phoneticians have accomplished in their domain is a small matter in comparison with the magnificent work of past and present linguists What Prof Bréal meant to point out was probably that when the historical phoneticians wish for explanations of the past facts of sound change, they must seek the sources of similar processes in living speech, this information can be obtained only through experimental phonetics It behoves experimenters, however, to recognise that in this direction they have been able to advance only a very small way

Experimental work was begun by men in other sciences, such as Brucke, Donders, Hermann, Helmholtz and others—nearly all physiologists, but the unification of effort into a science was the work of Rousselot. He is fully entitled to be called the "Father of Experimental Phonetics" E W SCRIPTURE

SIR GUILFORD L. MOLESWORTH, K C I E

THE death on January 21 at the age of ninety-six of Sir Guilford Lindsey Molesworth removes one whose name has long been a household word among engineers To few it is given to become a leader in his profession, but Sir Guilford Molesworth not only rose to distinction, and became the president of the Institution of Civil Engineers, but he also compiled a standard work of reference which has been carried into the remotest corners of the earth Published first in 1862, his "Pocket Book of Engineering Formulæ" passed through no fewer than twenty-four editions before 1900 A "Molesworth" was to be found in the pocket of practically every engineer, and its pages have been thumbed in many a difficult situation, knowing that its contents could safely be relied on.

Born in Southampton on May 3, 1828, nine years before Queen Victoria came to the throne, Sir Guilford was the son of the Rev J E N Molesworth, vicar of Rochdale, grandson of John Molesworth the mathematician, and was a descendant of the first Viscount Molesworth, created in 1716 He was educated at King's School, Canterbury, and at the College of Civil Engineering, Putney, and then was apprenticed to Fairbairn, the leading engineer of his day He gained experience in railway engineering on the London and North-Western Railway, and London, Brighton, and South Coast Railway, and during the Crimean War was employed in Woolwich Arsenal In 1859, at the age of thirty-one, he went out to the East in connexion with the first railway in Ceylon. that from Colombo to Kandy. Three years later he became chief resident engineer of the line, and in 1867 Director of Public Works From Ceylon, in 1871, he passed into the service of the Indian Government as technical adviser on railways and held that position until 1889, receiving the honour of knighthood in 1888 He had seen active service in Afghan and Burma, and after his retirement was employed in various government missions, such as reporting on the Uganda Railway He also became known as a writer on the decimal system, bimetallism, taxation, and other subjects. In 1904, at the age of seventy-six, he was chosen to succeed Sir William White, the great naval architect, as president of the Institution of Civil Engineers, and his address contains an admirable summary of the public works of India. Prefacing his remarks by a saying attributed to Macaulay to the effect that "a broken head in Coldbath Fields created greater excitement in England than three pitched battles in India," he reviewed the progress of the irrigation works and the railways of India, and referred to the Indian Government as "the purest administration in the world" Speaking of the resources of India, he said its coal fields covered an area of 35,000 square miles and contained some 20,000 million tons of coal

A man of extraordinary physical energy, when in Uganda in 1899 Sir Guilford cycled 46 miles on the hottest day of the summer "without experiencing any fatigue," and in the early part of the War, when well over eighty years of age, he served as a skilled mechanic in one of the munition shops of Messrs. Vickers at Crayford.

WE much regret to announce the death on January 26, at the age of seventy-one years, of Sir James Mackenzie, F R S, honorary physician to his Majesty in Scotland Sir James will be remembered as a pioneer investigator on cardiac disease, and only recently was awarded the Charles Mickle Prize offered by the University of Toronto for the best work to advance sound knowledge of a practical kind in medical art or science during the past ten years.

Current Topics and Events.

DURING the past week there have appeared articles upon a method of permanently moth-proofing wool, by the use of a substance of undisclosed composition, the product of a German dye firm These were supplemented by a lecture given at Australia House on Friday, January 23, in which the merits of this process were elaborated The tests made were on wool and furs, large quantities of eggs of the clothes moth being employed upon treated and untreated material under identical conditions Two forms of treatment are used—one a water-soluble material for goods that can be treated with water, the second, soluble in benzene and suitable for the dry-cleaning process It is claimed that after the water process, dry cleaning will not affect the goods, but dry-cleaning articles already treated by the dry-cleaning method will remove the protective substance Prof H Maxwell Lefroy has been good enough to favour us with the following comments upon the process "The nature of the water-soluble substance has been actually known in England for more than a year tests have been carried out in London with this material for eighteen months, and two new classes of moth-proofing substance have been discovered, which have all the merits of this material and in addition are far less costly and far simpler to apply As these are the result of inquiry instigated by commercial interests, it is not possible to disclose their composition, but it is unfortunate that the columns of reputable daily papers should be available for a description of a secret preparation under the guise of 'news,' made by a foreign firm In this particular instance, scientific research in England appears to be ahead of that in Germany but, as usual, has not been backed by resources in any degree comparable to those employed by the firm in Germany now vigorously exploiting a method that has already been superseded One may anticipate the adoption of the German substance in view of the vigorous publicity and the greater commercial enterprise in such chemical production"

A COMPREHENSIVE scheme for the publication of abstracts of biological research on an international scale has been developed in the United States and has received general support from scientific institutions in that country The proposals were put before the British Association at Toronto last summer, and a committee of the Royal Society is also considering the matter The subject was discussed at a representative meeting of British zoologists held in the rooms of the Zoological Society of London on January 10, when the following resolution was passed unanimously —"This meeting of British zoologists is of opinion that it is in the highest degree desirable that an effort should be made to extend the system of publishing comprehensive abstracts of zoological literature, and we desire to place on record our great appreciation of the work that has been done to this end by the American Committee for *Biological Abstracts.* We are, however, also of opinion that the scheme that has recently been submitted for our approval is open to serious objection in various directions Only some of these need here be mentioned, namely (1) The magnitude of the work involved appears to have been under-estimated (2) The financial arrangements so far made public are obviously quite inadequate for the purpose, which is a most serious point, it would be folly to assume that any publication of abstracts in pure science can be made self-supporting, and no scheme of this kind should be put into operation until satisfactory arrangements have been made for some permanent endowment (3) The proposal to publish the abstracts of the whole of biological literature in a single journal is unsatisfactory, such a journal would be extremely cumbersome and highly inconvenient for all classes of workers Bearing in mind the probable great increase of literature in the future, a much sounder plan would be to institute separate journals dealing with convenient sections of scientific work (4) The abstracts will be very much shorter than those now being published in this country, and this brevity will seriously detract from their value to most workers (5) The estimates for indexing are entirely inadequate (6) No provision has been made for the utilisation or co-ordination of the various biological abstracting organisations that already exist in this country and deal adequately with several branches of science, apparently it is proposed to reduplicate their work, but in a less useful form In the circumstances we consider that this scheme requires drastic revision"

THE application of science to problems connected with the cotton industry formed the subject of Dr A W Crossley's discourse at the Royal Institution on Friday, January 23 Nearly every branch of science has its bearing on the cotton industry Botanically, much work is being done on the structure of the cotton hair itself and its relation to the various processes, such as spinning, that it goes through during manufacture From an engineering point of view, it is extraordinary that no great invention has been made in regard to cotton machinery for more than fifty years, and the British Cotton Industry Research Association has already under consideration important modifications in one machine At the Shirley Institute laboratories, too, new light has been thrown on mercerisation, for which it has been found there is a definite limiting botanical factor Much valuable work has just been carried out on problems connected with bleachings Cotton well bleached should be white, but should not have suffered any deep-seated chemical changes such as would affect its physical properties or lower its strength, also bleaching is carried out by means of oxidising agents, and great care has to be taken as they attack the cellulose to form oxycelluloses. Unlevel dyeing may be a result The chemical tests that are used for determining the extent of this attack have been investigated, and it has been discovered that the slightest change of acidity or alkalinity of the liquor plays an important part The application of physics has produced a number

of important instruments for testing the regularity of yarns, their resistance to wear and to oscillating tensions, as well as their tension in the loom In a special regularity tester, the irregularities in a yarn are magnified 18,000 times by a shoe riding over it and a system of indicators and mirrors which produce on a moving bromide strip a photographic record of every minute change of twist and so act as an index to the action of the spinning machinery on the yarn The doubling twist can also be measured by the instrument Here another important achievement has been attained, for in conjunction with a special photometer which compares degrees of brightness, the right doubling twist that should be given to a singles yarn to produce the most lustrous effect has been discovered

AN interesting exhibition of photographs, paintings, and drawings from the third Everest Expedition is now being held at the Alpine Club Gallery, Mill Street, W In addition to views of Everest, the photographs by Capt J B L Noel show something of the interesting country through which the expedition passed Among them is a photograph of a gigantic figure of Buddha, more than forty feet high, from the Shekar Monastery It is said that within this figure there are stored many thousands of precious stones and other treasures The oil paintings and drawings by Mr Francis Helps, apart from their artistic merit, which is considerable, are of scientific value as a record of racial types and costume They depict Lepchas, Tibetans, and Sikkimese A portrait of the Maharanee of Sikkim and of a lady in full Tibetan dress are both very effective The latter wears the full Tibetan head-dress with false hair. A painting of a Lepcha woman has the old costume, now discarded, although the traditional dress of the men, also shown, is retained There is a very fine representation of a Red Lama in ceremonial dress with striking and strongly marked features A Bhutia girl with pronounced Mongolian characteristics, while not in itself unpleasing, in the heaviness of the type serves as a foil to the other female heads The artist has shown great skill in catching the differences in type and expression of the various races

A DISPATCH from the Cairo correspondent of the *Times* in the issue of January 20 records some noteworthy results obtained by the members of the Boston-Harvard Expedition this season in their excavations on the limestone plateau east of the pyramid of Cheops at Giza In clearing the Royal Cemetery of the Fourth Dynasty, boat-shaped cuttings were found in the rock foundation of the chapel of Cheops which had served as receptacles for the funereal boats of the dead king and his queens In one which has been uncovered, the bottom was made to fit the shape of the boat, and one of the slabs of the covering is still in position The most important find consisted of two small tombs of the Sixth Dynasty belonging to two priests, Qa'ar and Iduw, his son In the tomb of the former the entrance leads into a hall in which stand five figures each representing Qa'ar in one of his official capacities, with a little figure of his son Iduw. This tomb is of an entirely new type The tomb of Iduw also contains six life-sized figures, five of Iduw himself and one of his son On the walls are skilfully carved reliefs which include four scenes of men and women mourning, a subject rare at this period What is described as the gem of the whole find is a stele of limestone, coloured to represent granite, on the right-hand wall Starting high up on the wall, it reaches only half-way to the ground The rock beneath the lower edges has been hollowed out to form a rectangular niche in which the upper part of Iduw's body is carved life-size, as if emerging from the rock, with outstretched arms, palms upward, as though in readiness to receive the offerings the priests placed on the offering stone which lies in front It is an astonishing break from the formalism of Egyptian art, remarkable in the Old Empire

IN a lecture given in the Royal Exchange on January 20 on the Evolution of the Steamship, to the members of Lloyds' Students' Society, Eng-Capt Edgar C Smith, now the official guide lecturer at the Science Museum, South Kensington, suggested that if the members should be ever in need of technical information they could not do better than visit the Science Museum, where they would find models and diagrams in profusion and, moreover, the best technical library in Great Britain In the course of his lecture, Capt Smith said that the Science Museum deserves the support of every shipbuilder, shipowner and engineer in the country It is much more than a museum, it is the nation's permanent Palace of Engineering As compared with similar institutions, the Science Museum may be said to show how men have made their fortunes while the art galleries show how they have spent them It was Sir Richard Tangye, whose first success came with the construction of the hydraulic jacks used to push the *Great Eastern* into the Thames, who gave Birmingham its beautiful picture gallery, while it was Samson Fox, the inventor of the corrugated flue used in marine boilers, who built the Royal College of Music at South Kensington Bessemer, Hughes, Mond and many others had left large fortunes, but in the matter of legacies the Science Museum had been treated like a spendthrift and cut off without a shilling Though the engineering exhibits at the Museum are in a fair way to be properly housed, the same remark does not apply to the naval collections, and what is wanted now at the Museum is a National Gallery of Ships and Shipping worthy of the greatest port in the world, of the nation itself, and of our glorious heritage of the sea.

THE presidential address to the Royal Meteorological Society was delivered on January 21 by Mr C J P. Cave, who took as his subject, "The Present Position of Meteorology and Meteorological Knowledge" The Royal Meteorological Society celebrates its seventy-fifth anniversary this year In looking back Mr Cave stated that great progress has been made in the past 25 years, largely stimulated by upper air research Meteorology is at a disadvantage compared with other sciences, the number of posts open to meteorologists is very limited; and support for the Society has to come largely from amateurs.

The Society ought to encourage education in meteorological science But it is not only elementary meteorology that should be encouraged, there is a vast scope for research in the science, forecasting is only one of its branches, and except in the matter of forecasting, meteorology in Great Britain is the worst endowed of all the sciences Is it too much to hope that some great company or some public-spirited individual may come forward to endow a chair of meteorology in one of our universities and to make provision for research The Royal Meteorological Society is, so to speak, in a position of trust for meteorology, being the only independent body in the country especially devoted to that science It is true that there is the Meteorological Office, but its position at the present time is an unfortunate one, its future is uncertain In the past the Meteorological Office was directly under the Meteorological Committee, which administered a Government grant Soon after the War, the Office was placed under the Air Ministry It seems a grave anomaly that the Meteorological Office, which deals with problems of the greatest importance to many Government departments and to many public bodies, should be solely under the direction of the Air Ministry, more especially when there is in the Department of Scientific and Industrial Research a very suitable body under which it might have been placed.

SENATOR MARCONI has been elected an honorary member of the Institution of Civil Engineers

DR J H JEANS will deliver the sixteenth Kelvin Lecture of the Institution of Electrical Engineers on Thursday, February 5, at 6 o'clock The title of the lecture will be "Electrical Forces and Quanta" At the beginning of the meeting a statuette of the late Sir Joseph Wilson Swan will be presented to the Institution by Mr R K Morcom

APPLICATIONS are invited by the Scottish Society for Research in Plant-breeding for the directorship of research, in succession to Mr J M F Drummond, who was recently appointed Regius professor of botany in the University of Glasgow The applications, with statements of qualifications and experience (in each case seven copies), must reach the Secretary, 3 George IV Bridge, Edinburgh, by March 14, at latest

THE British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham, is inviting applications for three junior research posts, namely, a physical chemist or metallurgist (for work on atmospheric corrosion), a metallurgist or chemist (for the study of the wastage of copper locomotive fire-box stay rods), and a metallurgist with good physics training (for the study of zinc and high-zinc alloys and their workability) The latest date for the receipt of applications is February 9

THE four-hundredth anniversary of the death of Vasco da Gama, who was the first to reach India by the Cape route, and died on Christmas Eve, 1524, is being celebrated at Lisbon The *Times* correspondent reports that at a reception held at the Palace of Belem on January 24, representatives of twenty-six governments presented their credentials On January 25 there was a service at Belem Cathedral, and the blessing of the sea at the place whence da Gama sailed.

SIR JOSEPH J THOMSON has been awarded the Faraday Medal by the Council of the Institution of Electrical Engineers This medal is awarded not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution The present award is the fourth which has been made

THE Buchan prize of the Royal Meteorological Society was awarded to Mr W H Dines, at the annual general meeting held on January 21 The prize, now awarded for the first time, was recently founded to commemorate the late Dr Alexander Buchan, who did much to advance the interest of meteorology in Scotland and was intimately associated with the work done on Ben Nevis The award was made to Mr W H Dines for his recent papers on radiation read before the Society Mr C J P Cave, the president of the Society, in making the award, recalled the pioneer work which Mr Dines had done in the investigation of the upper air before he turned his attention to the problems of radiation

THE Gold Medal of the Royal Astronomical Society has been awarded by the Council to Sir Frank Dyson, Astronomer Royal, for his general contributions to astronomy, and in particular for his researches on the proper motions of stars The medal will probably be presented at the ordinary meeting of the Society on June 12 At the annual meeting, to be held on February 13, Prof Eddington, Dr Jackson, Mrs Maunder, and Prof Milne will speak on the progress of astronomy during the past year, Prof Fowler and Prof Newall will speak on the forthcoming meeting of the International Astronomical Union at Cambridge, and Dr Dreyer will give a short account of Tycho Brahe's observations, methods, and results

THE National Institute of Agricultural Botany is now prepared to accept entries for its fourth series of yield and quality trials of new varieties of potatoes from breeders who are willing to entrust the Institute with the marketing of their productions on a profit-sharing basis The trials are planned to last for five years, at first in Scotland only, but in the later years also in the English potato districts Only those varieties which do sufficiently well in the trials will be placed on the market Full particulars of the conditions of the trials can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge Applications should be made not later than February 28

SCHOLARSHIPS, each of the annual value of 300*l*, are being offered by the Grocers' Company for the encouragement of original research in sanitary science. There will also be an allowance to meet the cost of

apparatus and other expenses in connexion with the work The tenure of the scholarships is one year, with possible renewal for a second or third year Applications must be sent before April 1 to the Clerk of the Grocers' Company, Grocers' Hall, London, E C 2, from whom a form of application and further information may be obtained

CERTAIN of the members of the staff of the Rothamsted Experimental Station, Harpenden, Hertford, are available for a limited number of lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Agricultural Societies, Farm Workers' Associations, and similar bodies, on the work being carried on at the Station The subjects include various aspects of manuring and agricultural chemistry, physics and botany, the use of insecticides and fungicides, bee-keeping, and so on All communications regarding lectures should be addressed to the Secretary of Rothamsted Experimental Station

ACCORDING to the Report of the Council of the Zoological Society of London for December, the number of visitors to the Society's Gardens in Regent's Park during the year 1924 reached the total of 2,057,146—the largest number in the history of the Society, and an increase of 444,021 as compared with the previous year The number of visitors to the Society's Aquarium since its opening in April reached the total of 567,936 The number of fellows elected and readmitted during the year 1924 was 876, an increase of 374 as compared with the previous year, and a record never before reached in the history of the Society

THE collection of antique microscopes, about 400 in number, formed by the late Sir Frank Crisp, Bart, is to be offered for sale by auction at Stevens's Auction Rooms, Ltd, 38 King Street, Covent Garden, W C 2, on Tuesday, February 17 Catalogues can be had from the auctioneers

IT has been suggested recently that Messrs Oertling, Ltd, are importing parts of German balances and merely assembling them in Great Britain We understand that this is quite untrue. All Messrs. Oertling's balances are manufactured entirely at the firm's works in Turnmill Street, E C 1

Our Astronomical Column.

THE SOLAR ECLIPSE OF JANUARY 24 —Preparations were made at Greenwich for observing the first contact by the Innes method with several instruments, but thick clouds interfered There were frequent glimpses of the partially eclipsed sun, but nothing could be done except to note the change of illumination and of the colour of daylight The latter changed markedly near greatest phase, the cause, doubtless, being the absorption of light of short wave-length near the sun's limb There were some beautiful spectral colours on clouds near the sun

It is very welcome news that the conditions at the Yale Observatory, Newhaven, and elsewhere on the east coast of the United States, are described as perfect, and the photographs obtained there should be of great interest The following time determinations of totality are given in the telegrams (the figures are the corrections to the times computed from the almanac data) Yale $+4^{sec}$, Buffalo -2^{sec}, Ithaca $+5^{sec}$, Poughkeepsie $+3^{sec}$, Newhaven $+5^{sec}$, Long Island $+3\ 6^{sec}$ Mean $+3^{sec}$ The almanacs used a correction of $+8\ 0''$ to Brown's longitude (corresponding with $+7\ 0''$ to his mean longitude), but used no correction for the sun, which requires about $+1''$, or $+2^{sec}$ in the time of eclipse Hence it would appear that the correction applied to the moon was within $1''$ of the truth, but perhaps slightly too great

The country round New York was covered with snow, and the passage of the moon's shadow over this white surface, which was clearly seen, must have been a striking sight On the whole, the weather in the United States seems to have beaten expectations, which were not high owing to the season

OCCULTATION AND LUNAR ECLIPSE.—It is worth directing attention to the fact that the occultation of Aldebaran on February 2 is the last (at least for the neighbourhood of London) of the series that have been going on for some three years It will be followed by a blank period of nearly sixteen years Disappearance is at $23^h\ 54^m$, 4 hours west of the meridian, and reappearance 53 minutes later In view of Prof Brown's appeal, and the facilities for accurate time afforded by wireless, it is hoped that it will be extensively observed

The lunar eclipse of February 8, lasting from $20^h\ 8^m$ to $23^h\ 15^m$, will be favourably visible in Great Britain, the moon being high up Three-quarters of the moon's diameter will be obscured, and it may be possible to form some idea of the colour and illumination of the portion in the shadow These are now believed to depend on the meteorological conditions prevailing at the regions where the moon is in the horizon, so that they give a sort of integrated effect of terrestrial weather

THE NEW WOLF PERIODIC COMET —Although this object was of mag 17 on January 13, Prof M Wolf was able to make some interesting observations of its physical structure " It was a small nebulous object of fan or sector shape, $\frac{3}{4}'$ in width, somewhat less in height, with nuclear condensation in the point of the sector which was towards S S E " This structure and the cometary nature of the orbit leave no doubt that it is correctly classed as a comet The following orbit is by Dr A C D Crommelin from the photographic positions of December 22, January 13 (Heidelberg), and December 26 (Greenwich)

$$\begin{array}{ll} T & 1925,\ \text{January } 23\ 9624\ \text{G M T (new)} \\ \omega & \left.\begin{array}{l} 184^\circ\ \ 8'\ 27'' \\ \end{array}\right. \\ \Omega & 260\ \ 36\ \ 36 \quad \text{1924 0} \\ i & 23\ \ \ 7\ \ \ 9 \\ \phi & 21\ \ 57\ \ 47 \\ \mu & 472\ 951'' \\ \text{Period} & 7\ 5022\ \text{years} \end{array}$$

An ephemeris is of little use, for very few instruments can reach so faint an object

There is a very near approach of the orbit at aphelion to that of Jupiter There is no near approach at the next aphelion (nor has there been any in recent revolutions), but there will be a fairly close approach at the next aphelion but one Similar elements were obtained by Herr Kahrstedt, who gave the period as 7·43 years

Research Items.

THE CHRONOLOGY OF CENTRAL AMERICA —Mr R. C. E. Long in *Man* for January examines the bearings of the historical evidence upon the correlations of Mayan and Christian chronology put forward by Dr Morley and Mr Bowditch respectively. The argument turns upon whether it can be shown that Nahua influence existed in Chichen Itza before its overthrow by Hunnac Ceel, governor of Mayapan, or whether the Nahua buildings in the city—some of the greatest in Yucatan—were erected after that event, as Morley holds. A date deciphered by Morley on a ball-court —a typical Nahua structure—at Uxmal proves the existence of the Nahua in Yucatan before the date to which Bowditch assigned the fall of Chichen Itza If, then, it can be shown that Nahua influence in Chichen Itza also precedes the fall, that in the light of the Uxmal date would afford strong support to the Bowditch dating, but if it can be shown to be later than that event, it supports the Morley correlation It seems unlikely that the buildings at Chichen Itza which show Nahua influence would have been erected in a period of great wars, such as this is known to have been, when, as Morley thinks, the city had been handed over to Mexican mercenaries A conclusive piece of evidence, however, is a passage in the Chilan Balam of Chumayel which states that Hunnac Ceel had himself once been thrown into the Cenote of Sacrifice at Chichen Itza, and that, as he had survived the requisite time, he had been taken out and worshipped This custom of throwing victims into the Cenote was purely a Nahua practice and was introduced into Chichen Itza only after the establishment of Nahua rule It follows, therefore, that as the custom must have been observed before the overthrow of Chichen Itza by Hunnac Ceel and not after, the date of the ball-court at Uxmal would fall into line with and support the date suggested by the Bowditch correlation

MAGIC AND MEDICINE —An illustrated guide to the collections dealing with medical history in the United States National Museum, Washington, has been compiled by Mr Charles Whitehead, Assistant Curator of the Division of Medicine, and published as Article 15 of Vol 65 of the Museum's Proceedings These collections, which since 1916 have formed part of a larger section of the Department of Art and Industry covering the history of pharmacy, public hygiene and sanitation, are classified under magic medicine, psychic medicine, and pharmacological medicine, the last named including Egyptian, Greek, and Roman medicine, while the first covers the healing art of primitive, savage, and half-civilised man as well as the numerous survivals of primitive medicine among civilised peoples It is naturally the most fully represented Among the amulets or charms is a specimen illustrating the voodoo of the negroes of the United States and West Indies, which consists of a chicken feather, some human hair, a drop of blood on a rag, and a pine sliver This is worn on the neck as a preventive of voodoo against the wearer A number of "madstones," which, when applied to a dogbite, avert madness, have proved their efficacy in the hands of their former owners. For one, a highly polished seed of *Gymnocladus dioica*, the Kentucky coffee tree, 1000 dollars was asked, and a ball of matted hair, such as is occasionally found in the stomach of domesticated cattle and other ruminants, was said to have been used successfully in two cases One exhibit is a section of a tree from Norfolk, Va, which had been tapped, human (negro) hair inserted, and the hole plugged and sealed with clay Four inches of new growth formed over the plug, so that the hair must have been inserted fifty years before it was found The operation was doubtless performed either to relieve headache, or to cause headache in the original possessor of the hair.

THE BRITISH RACES OF *ARICIA MEDON*, ESPER —*Aricia medon* occurs in the British Isles in two distinct races, the type *medon* and the variety *artaxerxes*. The type occurs in England and Wales and the variety in Scotland and Ireland, but their areas of distribution overlap in the N E of England Dr. J W H Harrison and Mr W. Carter (Trans Nat. Hist Soc Northumberland, Durham, and Newcastle-upon-Tyne, N S, vol vi pt 1) have discussed the origin of these two races They reject both the possibility of origin from an original mixed population in N E England, and an explanation based on orthogenetic mutations They conclude that the variety originated in a contingent of the type isolated during the glacial period, under the long-continued influence of the refrigerating conditions that obtained at that time, and they cite the experimental results of refrigeration on other species of Lepidoptera in support of their theory They find, moreover, that in the overlapping areas of their distribution the inheritance follows Mendelian lines

MERISTEM GROWTH IN WOUNDED POTATOES —G. A C Herklots has a paper in the *New Phytologist* (vol 23, No 5, December 1924) in which the cork meristem formed upon cut potato tubers under suitable conditions is used as a means of investigating certain views recently put forward (NATURE, August 16, 1924, p 258, "Mechanism of Cell Growth") as to the influence of the external hydrion concentration upon the activity of meristematic protoplasm. Experimenting with the cut surface in contact with buffered solutions or jellies, he finds that an alkaline reaction at the cut surface favours rapid suberisation, but delays or (if beyond $P_H 8$) entirely prevents meristem formation, whilst an acid reaction at the cut surface, whilst delaying the process of suberisation, facilitates meristem formation

A CINCHONA INSECT PEST —In the report for 1923–24 of the Government cinchona plantations and factory in Bengal, attention is directed to the ravages of Helopeltis On the plantations both at Mungpoo and Munsong, this pest is on the increase and the attacks have reached and maintained a severity that renders hand-picking ineffectual The trouble is greater at lower than at higher elevations, and in certain parts of the plantations the growth of the plants is completely suspended for several months of the year Coppicing as a preventative is beneficial in so far as the affected portions are removed entire, but the disease reappears when the fresh shoots sprout. There seems to be no satisfactory method of dealing with this insect pest A season that is unfavourable to its development is more beneficial than all the counter measures that have been devised up to the present In spite of these difficulties and somewhat adverse weather conditions, the plantations did well during the year under review

ASIATIC SUCCINEIDÆ —One of the most difficult of the families of the non-marine mollusca to deal with satisfactorily is the Succineidæ The shells present so few salient characters, whilst far too little is known of their anatomy All the more credit, therefore, to Mr. H Srinivasa Rao, of the Zoological Survey of India, for the excellent little monograph he has just furnished of the Asiatic Succineidæ in the Indian Museum (Rec Indian Mus. xxvi). The author has

brought together all the facts he was able concerning the anatomy and habits of the members of the family as represented in the Indian Museum, and has principally utilised the jaw and radula for the purposes of distinguishing the various species The Indian Succineidæ comprise four distinct genera Succinea itself, which is amphibious, and three terrestrial genera—Indosuccinea, which is new, Lithotis, and Camptonyx The type of the new genus is *Succinea semiserica* Gould, and the author has further created a few new species and varieties There are good, clear text figures of the jaws and radula teeth and a very good photo-plate of the shells of the more important species

RATOONED QUEENSLAND COTTON —A short note by Mr Frederick Summers in the Journal of the Textile Institute for December has considerable general interest When growing wild, the cotton plant is always a perennial, but under cultivation, either because of drought or winter conditions in the resting season, or more usually because of the way in which the pests and diseases of the crop accumulate in the second and succeeding years, it is the rule in Egypt and the West Indies to remove the old stumps after the first year's crop of fruit has been gathered (NATURE, May 31, 1924, p 800) In S. America, and also in Africa under native cultivation, the plants are often cut down hard at the end of the growing season, and then allowed to produce fresh shoots in the following season, in other words, treated as from time immemorial bush and woody fruits have been treated in Great Britain In the case of cotton, this process is known as ratooning, and there has been much discussion, on inadequate data, as to whether the ratooned crop, whatever its quantity, is of similar quality with the first year's yield Fruit growers would naturally tend to assume that quality would be maintained, and one can understand that when new areas come under cultivation for cotton, the pest problem being still little developed, the planters have a natural tendency to follow the practice of ratooning. Queensland growers have done this, although in 1923 for a short period the process was made illegal, as the result of inquiries by the Queensland Ministry of Agriculture as to the esteem in which ratoon cotton is held in Great Britain This ban has again been removed, and Mr Summers now reports a careful test of the quality of ratooned fibre as against the normal crop, and it is interesting to see that this examination tells heavily against the ratooned product This conclusion is of great scientific interest and contrasts strongly with our experience of many perennial plants when brought into cultivation Mr Summers emphasises the fact that generalisation must not be based upon these Queensland samples alone, but they certainly raise the problem in a very definite form, and both its scientific interest and commercial importance should mean that further opportunities will be taken of comparing authentic samples of ratoon and normal cottons

THE JAPANESE EARTHQUAKE OF 1923 —The investigation of the disastrous earthquake which devastated Tokyo in September 1923 is still proceeding, but some preliminary reports have already appeared In the *Geographical Journal* for January, Dr C Davison has an article bringing together the information on the subject at present available, in which he discusses, among other aspects of the earthquake, its origin The epicentral tract of the earthquake was of unusual size and may have covered so much as 2000 square miles, including the whole of Sagami Bay Its area may even have been 4700 square miles The cause, at least in part, is to be sought in the movements which produced remarkable changes in the floor of Sagami Bay These changes were very considerable, and although no fault scarp has been discovered on the floor of the bay, a vast block or series of blocks seem to have subsided A remarkable feature of this subsidence is that the movements on the floor of the bay have affected very slightly the surrounding coasts The greatest elevation of the sea-bed was more than a hundred times that on land, and the greatest depression of the sea-bed was more than 1600 times that on land Moreover, the centres of elevation and depression are very close to one another There is also evidence that the movements on the sea floor were not confined to the time of the earthquake but continued in the same directions for so long as five months, and even now may not be at an end

MAGNETIC SURVEY WORK IN THE UNITED STATES. —The results of magnetic observations made by the United States Coast and Geodetic Survey in 1923 are published as No 268 of the survey publications. Five magnetic observatories continued in operation throughout the year, namely, Cheltenham, Md , Sitka, Alaska, Honolulu, Hawaii, Vieques Island, P R , and Tucson, Arizona. Their records have furnished the data for reducing to monthly means the values of declination obtained from field observations The magnetic survey of Florida was completed and a survey of North Carolina was made Declination observations were made at a large number of stations along the southern and south-eastern shores of Alaska in connexion with the triangulation Tables are given of the year's observations at various stations, and the report concludes with descriptions of the stations sufficiently detailed to enable them to be located even if the marking on the ground should be destroyed

ROTATORY DISPERSION —The thesis on "The Chemical Significance of Optical Dispersion," on which Dr Harold Hunter was recently awarded the degree of D Sc (Lond), has been printed and published (London Battersea Polytechnic, Battersea Park Road, S W 11; price 7*s* 6*d*). The thesis is a critical account of the recent position of a question which has formed the subject of considerable discussion both pre- and post-War It presents in a convenient and accessible form the author's own personal contribution to that discussion and his comments on the views of other workers in the same field There are very few points in the thesis which call for criticism, the principal one being perhaps the statement (p 89) that "the rotatory dispersion equation of Drude" "suffers from the defect" that "it does not take into account the degradation of the light energy in the phenomenon of absorption," since this "defect" does not exist in Drude's original equation, but only in the simplified equation which alone is quoted by Dr Hunter On the other hand, a partial transposition into italic type is justified as a tribute of admiration for the neat statement (p 49) that "One of the consequences of improvements in chemical technique is that *the dynamic isomerism of to-day becomes the static isomerism of to-morrow*"

THE CONDENSATION AND RE-EVAPORATION OF ACTIVE HYDROGEN —In an interesting paper (*Zeitschrift fur Elektrochemie*, Nr 21/22, pp 504-508, 1924) Fritz Paneth discusses the properties of active hydrogen and describes experiments carried out in association with K Peters The monatomic form (H_1), produced at low pressures by glowing wires and electric discharges, is readily adsorbed and is condensed on the walls of glass vessels cooled by liquid air, the activity disappearing on re-evaporation At high pressures another modification is produced,

usually regarded as tri-atomic hydrogen (H_3), in conformity with the observations of J J Thomson and Aston on positive rays H_3 is less strongly adsorbed than H_1 and can pass through glass wool It is generally recognised by the production of hydrogen sulphide, when it is passed at a very low temperature over powdered sulphur Wendt and Landauer have described an investigation in which they appear to have been successful in producing not only condensation but also re-evaporation of H_3 without change of form, and, considering the substance analogous to ozone, they suggest for it the name "hyzone" Two new methods are now described in detail for the production and study of this active modification of hydrogen In the first, hydrogen is passed over a glowing Nernst filament, and in the second, through a heated capillary tube of palladium The results are believed to prove that active hydrogen so produced may be condensed and re-evaporated without loss of activity, and further, that its constitution must be H_3 and not H_1 Experiments are to be continued with the view of producing the active modification in greater quantities

THE ISOTOPES OF MERCURY —An interesting suggestion is made by Dr F Stumpf in the *Zeitschrift fur Physik* of December 12. He directs attention to the facts that Aston has found the atomic weights 204, 202, 200, and 197 for the isotopes of mercury, and that the last number is almost identical with the atomic weight of gold Although among the radioactive elements there are cases where different elements have the same atomic weight, this is not true for the other, non-radioactive, elements, and the author considers that it is possible that the 197 isotope was really gold and not mercury Apparently the intensity of the 197 line was not very different from that of the others, so that it can scarcely have been due to gold existing originally as an impurity in the mercury It is suggested that gold may have been produced from the mercury in the experiment in a similar manner to that in which Miethe claims to have caused this transformation It might be possible to obtain evidence of this by receiving the positive rays on a plain sheet of glass or of quartz, instead of on a photographic plate, with a long exposure the glass might be coloured red with colloidal gold at the point in question In Miethe's experiment parts of the discharge bulb were coloured red

PROTECTIVE COLLOIDS —A paper on colloidal protection, read by J Alexander before the American Section of the Society of Chemical Industry last May, is published in *Chemistry and Industry* (Review) for December 19, 1924 The technical use of protective colloids has been known since antiquity Thus the Chinese used glue in the manufacture of ink to deflocculate the lamp-black, and the ancient Egyptians used gum (probably acacia) for the same purpose The protective action was recognised by Meyer and Lottermoser (1897) A protector may be defined as a substance which opposes the aggregation of molecules or particles into larger groups, according to Bechold, the protective action is consequent upon the adsorption of a layer of the protector at the interface between the dispersed and the dispersing phase This layer is exceedingly thin, since it does not diminish the Brownian motion of the particles, and there is no ultramicroscopic evidence of its existence Brief descriptions and applications are given of plural, auto- and cumulative protection

PYROPHORIC ALLOYS —The production and properties of pyrophoric alloys are described by Dr N F Budgen in the *Chemical Trade Journal* for December 26, 1924 The "flint" of the popular type of gas-lighter was introduced by Auer von Welsbach in an interesting manner The incandescent mantle which Welsbach introduced in 1886 contains 99 per cent of thoria and 1 per cent of ceria, and the large demand for thoria which it created led to the working up of the monazite sands found in different parts of the world These sands contain about 5-10 per cent thoria and 50-60 per cent ceria and other rare earths, so that large quantities of rare earths, minus the thoria, accumulated at the mantle works It was while trying to find a use for this "waste" that Welsbach discovered that alloys of iron and the cerium metals throw off sparks when rubbed with a file The first step in the production of pyrophoric alloys is the preparation of "misch metal," which is an alloy of 40-50 per cent cerium, 20-40 per cent lanthanum, 1 per cent yttrium, and small amounts of neodymium, samarium, gadolinium, etc This alloy is then fused and mixed with an appropriate metal (*e g* iron, zinc, aluminium) in the molten state under a protective layer of salt or fluorspar. The best pyrophoric alloy is probably "auermetal," made by alloying up to 60 per cent of iron with misch metal

PHYSICAL ASPECTS OF CHEMICAL COMBINATION — A paper on "Chemical Combination as a Dynamic Problem" by Prof Born, of Gottingen, read at Innsbruck meeting of the German Scientific and Medical Association on September 26, 1924, is printed in *Die Naturwissenschaften* of December 26 The paper deals with the calculation of physical and chemical constants from data as to the electric charges and distances of the components of various aggregates Thus the "lattice energies" of crystals of the rock-salt type can be calculated and give results which show a very close agreement with the observed values In other cases, including the molecules of salt-vapours, the ions appear to be deformable, as indicated, for example, by the different refractive power of Cl′ in HCl and in NaCl A table is, however, given of the energy of formation of salt-vapours, in comparison with the lattice energy minus the heat of sublimation The calculation of the natural free-periods of ions such as CO_3, NO_3, ClO_3, SO_4, etc, which are constant in all compounds of these ions both in solution and in solid crystals, from the charges and distances of the atoms, is also referred to

THE PROGRESS OF DEVELOPMENT OF A PHOTOGRAPHIC PLATE —This matter has been investigated by Mr L F Davidson, of the Imperial Dry Plate Company (Journal of the Royal Photographic Society, January 1925), by watching the actual process of development under the microscope, using a high-power objective, and by taking photomicrographs at various stages The developer was coloured so that its movement was obvious When the developer reaches a grain, there is a definite time interval before visible action begins, and this "induction period" varies according to the developer used and according to the nature of the grain, but appears to be unaffected by grain size Development starts at points or "centres" which enlarge and join until the whole grain is blackened Except in the case of certain slow emulsions, the shape of the grain is changed by its development If by reason of this change of shape it comes into contact with another grain, this second grain appears to be rendered developable The developed grain may present an area that is smaller or very much larger than the original silver haloid grain, this alteration in area varying from 0 8 to 104 per cent in an extended series of experiments It was sought, though apparently not very successfully, to find some relationship between the increase in size and the character of the plate

Prize Awards of the Paris Academy of Sciences.

AT the annual public meeting of the Paris Academy of Sciences, held on December 22, M Guillaume Bigourdan in the chair, the prizes awarded in 1924 were announced as follows

Mathematics —The Poncelet prize to Ernest Vessiot, for the whole of his mathematical work, the Francœur prize to the late Ernest-Malo, for his researches in algebra and arithmetic

Mechanics —The Montyon prize to Eugène Huguenard, Antoine Magnan, and André Planiol, for the important improvements which they have made in hot wire anemometry, the Fourneyron prize to Marcel Crozet-Fourneyron, for his historical work and inventions connected with the hydraulic turbine, the Boileau prize to Georges Routin, for his hydraulic researches, the Henri de Parville prize to Paul Bloch, for his work in ballistics, with especial reference to the projection of missiles from aeroplanes.

Astronomy —The Lalande prize to Jules Baillaud, for his work in celestial photography, the Janssen medal to George Willis Ritchey, for his work on the construction of mirrors, the La Caille prize to Dominique Saint-Blancat, for his work on the catalogue of stars The Benjamin Valz prize was not awarded

Geography —The Delalande-Guérineau prize to Charles le Maître, for his cartographical work in Algeria, the Gay prize to Émile Delcambre, for his work in topography and meteorology, the Tchihatchef prize between Ernest Benoit (1500 francs), for his work on geodesy in Indo-China, and Laurent Friquegnon (1500 francs), for geographical work in Indo-China, the Binoux prize between Jacques Bourcart (1000 francs), for his work on the physical geography of Albania, and Édouard de Martonne (1000 francs), for his topographical, geodesic, and cartographical work in French Western Africa

Navigation —The prize of 6000 francs between Yves Le Prieur (4000 francs), for inventions connected with naval artillery, and Émile Georges Barrillon (2000 francs), for his study of the gyration of ships, the Plumey prize between Antoine Foillard, for his memoir on marine machines with electric transmission, and Paul Dumanois, for his volume on internal combustion motors

Physics —The La Caze prize to Paul Langevin, for the whole of his scientific work, the Hébert prize to Edgar Haudié, for his "Cours d'électricité générale", the Hughes prize to Alexandre Dufour, for his cathodic oscillograph, the Clément Félix prize between Jean Mercier, for his researches on the velocity of propagation of electric waves, and Pierre Fleury, for his researches on the measurement of the temperatures of electric furnaces

Chemistry —A Montyon prize (Unhealthy Trades) (2500 francs) to the late André Brochet, for his researches in organic chemistry and electro-chemistry, an honourable mention (1500 francs) to Isidore Lazennec, the Jecker prize to Louis Jacques Simon, for his work in organic chemistry, the La Caze prize to Camille Matignon, for the whole of his chemical work, the Cahours foundation to Suzanne Veil, for her physico-chemical researches on metallic oxides and hydroxides, the Houzeau prize to Pierre Chevenard, for his inventions of apparatus used in metallurgical research

Mineralogy and Geology —The Fontannes prize to Frédéric Roman, for his work in palæontology, the Victor Raulin prize to Jules Barthoux, for his memoir on the petrographical and geological study of the Arabian desert

Botany —The Desmazières prize to René Vandendries, for his memoirs on sexual determinism and sexuality of the Basidiomycetes, the Montagne prize to Alphonse Labbé, for his volume on the biological cycles of the Dunaliella, the de Coincy prize to François Pellegrin, for his memoir on the flora of Mayambe, from the collections of M G Le Testu.

Anatomy and Zoology —The da Gama Machado prize to Christian Champy, for his researches on the spermatogenesis in *Discoglossus pictus*, the Savigny prize to Clodomir Houard, for his work on galls in Northern Africa, the Jean Thore prize to Adrien Perret-Maisonneuve, for his researches in apiculture

Medicine and Surgery —The Montyon prize between Victor Babès (2500 francs) for the whole of his work, Noel Fiessinger (2500 francs), for his volume on the ferments of the leucocytes in physiology, pathology, and general therapeutics, Jules Botreau-Roussel (2500 francs), for his memoir "Ostéites pianiques (Goundou)", honourable mentions (1500 francs) to Jean Baratoux, for his volume on the voice, the scientific study of its formation and emission, its diseases, to Jean Rieux, for his book on clinical hæmatology, and to Henri Glover, for his work entitled "L'auscultation électrique en physiologie et en clinique", the Barbier prize to Georges Mouriquand and Paul Michel, for their experimental work on accessory food substances, the Bréant prize (arrears) between Alfred Boquet and Léopold Nègre (2500 francs), for their work on tuberculosis, and Léon Marchand and Raymond Moussu (2500 francs), for their work on enzootic encephalitis of the horse, the Godard prize to Edmond Papin, for a memoir on endoscopy operations of the urinary passages, the Mège prize to Mme Angélique G Panayotatou, for her volume on the hygiene of the ancient Greeks, the Bellion prize between Paul Godin (700 francs), for his works on the evolution of growth, and Louis Bargeron (700 francs), for his researches on the lighting conditions of workshops, the Larrey prize to François Bassères, for his memoir on the medical service of the Third Army in the War

Physiology —The Montyon prize to André Charles Guillaume, for his memoir on the normal and pathological morpho-physiology of the small superficial blood vessels, the La Caze prize to Emmanuel Hédon, for his scientific work as a whole, and more especially for his researches on the physiology of the pancreas, the Pourat prize to André Paillot, for his memoir on the bacterial diseases of insects and their utilisation in agriculture, the Martin-Damourette prize to Henri Vignes, for his memoir on normal and pathological obstetrical physiology, the Philipeaux prize to Antoine Léon Garrelon and Daniel Santenoise, for their researches on the oculo-cardiac reflex and vago-sympathetic toxin

Statistics —Montyon prizes to Michel Huber (1000 francs), for the whole of his statistical work, and Émile Lambert (1000 francs), for his work in statistics

History and Philosophy of Science —The Binoux prize to Mme Hélène Metzger, for her volume on chemical doctrines in France from the beginning of the seventeenth to the end of the eighteenth century

Medals —The Berthelot Medal to André Brochet, Louis Jacques Simon, Camille Matignon, Suzanne Veil, and to Pierre Chevenard

The Lavoisier Medal to Joseph Achille Le Bel, for his chemical work, as it is now fifty years since the discovery of the asymmetric carbon atom

General Prizes —The Grand Prize of Mathematical Sciences to Paul Montel, for his researches on suites of analytical functions; the Bordin prize to Clément Vaney, for his work on the diseases of cattle, the Lallemand prize to Henry Cardot and Henri Laugier,

for the discovery and study of the linguo-maxillary reflex, the Vaillant prize to Claude Guichard, for the whole of his work in higher geometry, the Le Conte prize to André Debierne, for his work in the field of radio-activity, the Houllevigue prize between Franz Lœwinson Lessing (3500) francs), for his work in petrography, and T. Husnot, for his work in botany, the Jean Jacques Berger prize to the Institut prophylactique, the Parkin prize to Ernest Fourneau, for his work in pharmacology, the Saintour prize equally between Paul Camboué, for his researches on silks of Madagascar, and Jean Jacques Kieffer, for his work on parasitic Diptera and Hymenoptera, the Henri de Parville prize to Maurice Vèzes and Georges Dupont, for their book on resins and turpentines and the industries connected with these, the Lonchampt prize between Émile Roubaud (2000 francs), for his work on the hibernation of flies, Ernest Lobstein (1000 francs), for his biochemical researches on the tubercle bacillus, and Paul Fleury (1000 francs), for his researches on laccase, the Henry Wilde prize to Charles Maurain, for the whole of his work and for the organisation of research at the Institut de Physique du Globe, the Caméré prize to M. Caquot, for his engineering work in connexion with bridge construction, the Gustave Roux prize to Eugène Séguy, for his work on Diptera, the Thorlet prize to Adolphe Richard.

Special Foundations.—The Lannelongue foundation between Mmes Casco and Ruck.

Prix des Grands Écoles.—The Laplace prize to Philippe Charles André Coste, the L. E. Rivot prize between Philippe Charles André Coste, Lucien Félix Chadenson, Jean Charles Joseph Armanet, Vincent Louis François Pierre Bauzil.

Funds for Scientific Research.—The Gegner prize to Gustave Dollfus, for his geological work, the Jérome Ponti foundation to the late Hippolyte Coste, for his descriptive and illustrated flora of France, the Hirn foundation to Georges Giraud, for the whole of his work; the Henri Becquerel prize to René Garnier, for his works on differential equations.

The Loutreuil Foundation.—Thirty-two requests for grants from this fund were received, twenty-four grants were made as follows:

Establishments named by the founder.

National Museum of Natural History: 10,000 francs to P. Pierre Teilhard de Chardin, for palæontological researches in China, Collège de France, 15,000 francs to Henri Piéron, for the purchase of material for researches at the new physiological laboratory;

National Veterinary School at Alfort: 2000 francs to Albert Henry and Charles Leblois to pursue their researches on the etiology, pathogeny, and treatment of the parasitic skin affections of domestic animals, 3000 francs to Gabriel Petit, to pursue his researches on the radio-activation of the organism by intravenous injections of radium, 4000 francs to Gustave Moussu, for his researches on diseases of cattle and pigs, 2000 francs to François Maignon, for his work on insulin and on the mineral elements entering in the constitution of the tissue catalysts of animal and vegetable origin.

National Veterinary School of Lyons: 2000 francs to Gabriel Marotel to continue his researches on two parasitic diseases of the horse and dog, 4000 francs to Joseph Basset, to finish his researches on anthrax vaccination, 2000 francs to L. Jung, to pursue his researches on the rôle of the saliva of various domestic animals in its relations with their normal food regime.

National Veterinary School of Toulouse: 2000 francs to Jules Girard and Pierre Pons, for their researches on the modifying factors of growth (temperature, special feeding, castration), 3000 francs to Albert Daille, to finish his researches on the etiology and serotherapy of epizootic diarrhœa in newly-born calves, 2000 francs to Clément Bressou, to commence researches on the splanchnology of mammals, more particularly Carnivora, by the method of feeding and radio-opaque injections.

Grants acceded to establishments admitted for one year by the president.

Conservatoire national des arts et métiers: 4000 francs to Léon Guillet, for the purchase of a second Le Chatelier metallographic bench.

Independent requests: 1500 francs to Jean Bosler, for the *Journal des Observateurs*, 5000 francs to Jean Charcot, for the purchase of material required for the geological study of the sea floor, 3000 francs to Henri Colin, for the purchase of a combustion furnace and accessories, required in connexion with the study of new or little known carbohydrates, 1000 francs to Benjamin Jekhowsky, for assisting his work on new minor planets, 15,000 francs to Jean Mascart, for the publication of observations of variable stars, 3000 francs to the Office central de Chauffe rationnelle, for the study of the composition of a mixture of carbon monoxide and dioxide in equilibrium in the presence of carbon at various temperatures, 1500 francs to Paul Pallary, to pursue his explorations in the Middle Atlas, 5000 francs to Edmond Roy-Prémorant, for the construction of a tachylegometer invented by him, 6000 francs to the Société de Physique industrielle, for the study of the measurement of gas and steam in industry, 6000 francs to the Saint-Joseph University of Beirût, for the publication of the geological map of Syria, constructed by P. Godefroid Zumoffen.

The Bouchard foundation to Gabriel Bidon, to continue his researches on the neuro-physiology and treatment of the deformed, the Henry Le Chatelier foundation to Léon Jacqué, for researches on the fusibility of mixtures of lime, ferrous, and ferric oxides.

Medical Uses of Radium.

THE Medical Research Council has recently published, as No. 90 of its Special Report Series, a summary of reports for 1923 from research centres on the medical uses of radium. The nine clinical centres in Great Britain and Ireland which enjoy the use of radium lent to them by the Medical Research Council have been pursuing these investigations for several years, but this is the first occasion upon which the data have been arranged and used for public circulation. This is particularly welcome now, for results have been obtained which invite the careful consideration of radiologists, physicians, surgeons, and pathologists.

It may be said that the main object of the clinical investigations is to define the proper limitations of the uses of radium in the treatment of malignant disease, and to decide the best methods of treatment for any given type of this disease. Such an aim can be achieved only by very persistent work of a collaborate character continued over some years. The forms of malignant disease are so varied, the differences in reaction of the host are so large, and the factors in dosage are so numerous, that it may well be that more years will elapse before the main object of the Medical Research Council in these investigations is achieved. Yet a perusal of this report convinces the reader that a serious effort is in hand, not only to give these radiological investigations a quantitative

basis, but also to visualise the problem of radium therapy in cancer in all its complexity and yet not be baffled by it

For some years it has been recognised that rodent ulcer is a disease very amenable to this form of therapy, and this is confirmed in the data before us Of later years, the value of radium in cancer of the cervix uteri has been maintained, and there is a considerable mass of evidence in this report which substantiates the claim In cancer of the breast, the data show an increasing use of radium combined with surgical operation, but the full value of this combination depends largely upon the nature of the surgical operation and the extent to which it is possible to insert the radium at places of likely extension of the disease We gather from the report that the results obtained by the use of radium in malignant disease of the mouth, jaw, or throat, continue in most cases to be disappointing This appears to be chiefly due to local anatomical and surgical difficulties rather than to any specific resistance of the tumours themselves

Non-malignant conditions have also been investigated It is satisfactory to find in the reports from three independent centres, a practical uniformity in the dose of radium employed in the treatment of uterine fibromata and of menorrhagia, and an equal measure of success in the results

Recognising that progress in therapy is largely dependent upon collateral researches, the Medical Research Council, through its Radiology Committee, has, from the inception of this scheme, supported such researches which have so far been of physical or biological character Sir Ernest Rutherford reports upon the disintegration of the elements by means of alpha rays

Researches of a biological character are separately detailed as having been carried out by Mr Timbrell Fisher in osteo-arthritis, by Dr J C Mottram on changes in the intestinal tract resulting from radiation, and by Prof S Russ upon the determination of lethal doses of radiation for animal tumours

The publication as a whole is worth serious study, for it is a finger-post along the road of treatment in malignant disease While there are no extravagant claims made for it, it cannot be doubted that radium is a valuable instrument in the treatment of cancer and other diseases, and we look with confidence to the results which these investigations may provide in the near future

Chemistry in India.

THE success which has attended the inauguration of the Indian Science Congress, and the great increase in the amount of new work in chemistry which has occurred in the Indian Empire during the past ten years, has led to the establishment of an Indian Chemical Society, under the presidency of Sir P C. Rây, with offices at 92 Upper Circular Road, Calcutta ; the first number of the Quarterly Journal of the Society has now appeared

Hitherto, chemical papers emanating from India have been published either in the Journals of the Chemical Societies of London or America, or in one or other of the larger continental publications The disadvantages attaching to this procedure became more and more obvious as the volume of new work increased, because the older Journals are becoming over-burdened, and the need for economy of space necessitated frequent correspondence between authors and editors, entailing grave loss of time in the cases of countries so far distant as India

Apart, therefore, from the pleasure with which all British chemists will welcome this national effort on the part of India, there will be general agreement among them that the scheme of decentralisation of publications within the British Empire which it implies is the only one which can lead to the rapid and adequate publication of new knowledge and tend ultimately to the real advancement of chemistry Optimists may dream of the time when there will be one Chemical Society and one Chemical Journal for all the English-speaking races, but until the transportation of matter can be accomplished with a velocity approaching that of light, distance must always act as an obstacle to any such plan, however desirable it may be

The new Journal is a welcome illustration of the development which has taken place in Indian chemistry during recent years There are thirteen papers, and only one of these is published under English names The remaining papers are published by Indians and come from all parts of the Indian Empire Four of them emanate from the College of Science, Calcutta, and this is as it should be, because, for many years past, this Institution has been the backbone of chemical research in India The other communications come from Allahabad, Baroda, Dacca, Cuttack, Benares, and Madras, and constitute a series of which the organising committee and editor have every reason to be proud

The Journal is well printed, and doubtless the structural formulæ, which seem, at times, to have given the printer some trouble, will improve with experience Older chemists with impaired eyesight will probably quarrel with the colour of the cover, the printing on which is most difficult to read, but these are minor points and do not detract from the value of what is essentially a most creditable and important production. J. F. T.

The Ross Barrier.

IN a paper to the Royal Geographical Society on January 19, Mr C S Wright gave an account of the Ross Barrier and the mechanism of ice movement There is now little doubt that the barrier is bounded by high land on all sides except the north, although the ranges between Edward Land and the Maud ranges have still to be discovered. The area of this ice sheet may be given as approximately 150,000 square miles. Ample proof is forthcoming that the seaward edge of the barrier is afloat, although it is probably aground at the site of Amundsen's winter quarters east of the Bay of Whales Observations have proved that the slope of the barrier is very slight and this must be interpreted as evidence that the barrier is afloat even quite close to its southern edge

The barrier movement is compounded of the result due to the thrust of glaciers from the plateau on the west, south and east, and movement due to the flattening and outward extension of a thick mass of ice under its own weight Mr. Wright gave evidence in support of the view that these two causes are roughly of equal importance. If no movement were

contributed by glacier thrust, certainly the general level character of the barrier surface would be maintained, provided that the barrier rests on a warm frictionless plane—the sea If it rested on land, the bottom friction would be high, the temperature low, and the movement slight On the other hand, the fact that there is little or no local thickening in the region of the outflow of land glaciers to the barrier must indicate an efficient water circulation beneath it In that case, local thickening would involve local depression and increased local melting from below, thus the general surface level would be maintained It is not possible to suppose that floating glacier tongues played no part in the formation of the barrier. Such tongues are common in the Antarctic and many of them extend far out to sea.

The barrier had probably a twofold origin Numerous floating ice tongues from the large glaciers at the back of the Ross Sea were no doubt cemented together by sheets of sea-ice formed in situ in the areas between them The latter process would entail the formation of sea-ice and precipitation of snow thereon at a rate exceeding that at which it melts below

These conditions were certainly possible during the period of maximum glaciation, even if they do not now occur Observations have shown that the rate of increase in thickness of sea-ice does not decrease largely as the thickness increases This points to the fact that conduction of heat from below is not the sole cause of growth. At present there are sheltered positions in which sea-ice can form and maintain itself for more than one year. Mr Wright, in discussing the mechanism of movement of ice, shows how uncertain and incomplete are our data for the rate of advance of the barrier, its snowfall and contributions to its mass from land glaciers.

University and Educational Intelligence.

ABERDEEN —The University Court has resolved to institute a lectureship in clinical chemistry

Dr. Alexander Bowman has been appointed lecturer on the scientific study of fisheries

CAMBRIDGE —The Statutory Commissioners have been approached by a number of members of the Senate on the question of the retiring age for professors, which was fixed in the recommendations of the Royal Commission at 65 years The Commissioners favour the proposal that the Board of Electors to a professorship may, when a professor reaches the age of sixty-five, invite him to hold office up to an age not exceeding seventy, if it is believed that the interests of the University will best be served thereby The Board of Electors is to be precluded from making any fresh election of a professor who is already more than 65 years of age, but if a candidate is elected who is over sixty, he may be elected to hold office up to the age of seventy

Mr W B R King, Magdalene College, has been reappointed assistant to the Woodwardian professor of geology On the nomination of the Department of Scientific and Industrial Research, Sir Joseph Broodbank is being appointed to the committee of management of the Low Temperature Station for Research in Biochemistry and Biophysics

The Special Board for Mathematics has reported to the Senate, asking the University to take steps to enable the Tyson Medal to be struck in bronze, instead of in gold as at present, and to be accompanied by a prize in money

The Board for Engineering Studies has recommended certain changes in the regulations for the Mechanical Sciences Tripos, including the sub-division of certain of the advanced subjects necessary for a First Class Thus electricity and magnetism is replaced by electric power and electric signalling, and theory of structures and strength of materials by theory of structures (civil) and theory of structures (mechanical) Mechanics of machines also figures for the first time as a separate subject It is proposed also to establish jointly with the University of Birmingham a diploma in coal-mining engineering, for which the general course of engineering at Cambridge should count as part of the training, this course to be followed by four months' practical experience in a coal mine and a year's course in mining at the University of Birmingham

EDINBURGH —At the meeting of the University Court on Monday, January 19, the resignation of Sir Harold J Stiles, Regius professor of clinical surgery in the University, to take effect on March 20, was announced The Principal expressed the great regret which was felt by the Court, the high appreciation of the eminent services which Sir Harold Stiles had rendered to the University, and the sense of the deep loss which would be sustained upon his retirement, not by the Court alone but by the University as a whole

The Library of the Geology Department of the University has been indebted for a number of years to the late Sir Archibald Geikie for donations of valuable geological literature The last consignment has recently been received from his daughters This Library was gradually built up and strengthened by the Geikie brothers who in turn filled the chair of geology

LONDON —A course of eight free public lectures on "The Chemistry of the Internal Secretions" will be given by Mr E C Dodds, at the Middlesex Hospital Medical School, at 5 o'clock, on February 3, 5, 10, 12, 17, 19, 26, and March 3, one of four by Dr J. Duncan Scott, on "The Medullary Centres," at the Physiology Department of St Bartholomew's Hospital Medical College, 6 Giltspur Street, E C, at 5 o'clock, on February 11, 18, 25, and March 4, and one of four by Sir William I de Courcy Wheeler, at St Bartholomew's Hospital Medical College, at 5 o'clock, on February 16, 17, 18, and 19, on "Some Practical Considerations and Experiences in the Conservative Treatment of Fractures of the Pelvis and the Lower Extremity" Two courses of free public lectures at Birkbeck College are announced, namely, four, by Dr G G Coulton, on "Medieval Education" (February 2, 9, 16, and 23), and three, by Prof E N da C Andrade, on "The Structure of the Atom" (February 5, 12, and 19) The lecture hour in each case will be 5 30, and no tickets will be required

ST ANDREWS —The degree of Ph D has been conferred on Mr. G R Ross for a thesis entitled "The Serological and Immunological Characteristics of Tubercle Bacilli after Extraction with Fat Solvents"

APPLICATIONS are invited for two lectureships at University College, Leicester, viz in physics and in chemistry The applications must reach the secretary of the college by February 13 at latest.

DR. WALTER MAKOWER has been appointed professor of science at the Royal Military Academy, in succession to Prof J Young, retired. Dr de Mouilpied, who was to have filled this post, resigned without taking up the appointment Dr Walter Makower, who was lately chief physicist to the Dunlop Rubber Company, was for many years lecturer in physics at the University of Manchester.

Societies and Academies.

LONDON

Royal Society, January 22.—H. C. H. Carpenter and Miss C. F. Elam: Experiments on the distortion of single-crystal test-pieces of aluminium. Single crystal test-pieces of aluminium can be extended up to 7 per cent. without recrystallising on heating to 600° C. They will recrystallise to form either another single crystal of a different orientation or several crystals, according to the degree of strain. When a large crystal grows from a number of small ones, it has no particular orientation or relation to the direction of mechanical strain. Unless the metal recrystallises, the distortion of the crystal is not removed by heating, and unless the metal recrystallises, the heating does not remove the whole of the hardness acquired through mechanical strain. Hardening by mechanical deformation can take place independently of change of orientation. The proportional increase in hardening is greatest during the early stages of extension, but in the case of single crystals a stage is reached when the increase in hardness is approximately proportional to the amount of plastic deformation.—W. S. Farren and G. I. Taylor: The heat developed during plastic extension of metals. Hollow bars of certain metals were subjected to plastic stretching. The work done on a measured length in the middle of the specimen was measured, and at the same time the rise in temperature at the centre of the bar was recorded. The heat generated varied from 86.5 per cent. of the heat equivalent of the work done, in the case of annealed steel, to 95 per cent. in the case of single-crystal specimens of aluminium. This ratio remained constant for one material during the whole range of the extension, which in the case of aluminium amounted to more than 50 per cent. of the initial length.—J. V. Howard and S. L. Smith: Recent developments in tensile testing.—R. L. Smith-Rose and R. H. Barfield: On the determination of the directions of the forces in wireless waves at the earth's surface. The propagation of wireless waves over the earth's surface implies the reception of two or more distinct waves at an appreciable distance from the transmitting station. One of these is assumed to arrive at the earth's surface after reflection or refraction from the upper portions of the atmosphere, and an attempt is made to detect it by measuring the inclination of the wave-front of the arriving wave. Such a down-coming wave would give rise to a reflected wave which, at the earth's surface, will interfere with the incident wave in such a way as to tend to eliminate the horizontal component of the electric force and the vertical component of the magnetic force. The conductivity of the earth at wireless frequencies was determined experimentally by measuring the "forword tilt" of the waves arriving from neighbouring transmitters for a number of sites in South England. A moderately consistent value of about 10^8 (e.s.u.) was obtained, and calculations from this value show that the directions of the resultant forces at the surface will always be sensibly the same as those of a horizontally propagated wave.—D'Arcy Thompson: On the thirteen semi-regular solids of Archimedes, and on their development by the transformation of certain plane configurations. The thirteen isogonal non-isohedral solids attributed to Archimedes stand in close relation to the ten regular plane repeating patterns or "nets" first described by Kepler, which consist of regular and identical sets of congruent polygons. If, in the table of indices giving the number of triangles, squares, etc., found at each junction (or node), the *order* of an index be successively reduced, we pass accordingly from the plane polygonal assemblage to some one, and then to another, and so on, of the indices which characterise the several polyhedra. This transformation may be performed mechanically, by constructing a hinged net, removing (*i.e.* replacing by fenestræ) the polygons of a certain order, and allowing those which remain to slide over and so overlap one another.—F. G. Mann and Sir William Pope: 1.2.3-Triaminopropane and its complex metallic compounds.—D. L. Chapman, J. E. Ramsbottom, and C. G. Trotman: The union of hydrogen and oxygen in presence of silver and gold. The catalytic activity of silver is considerably reduced by heating to dull redness in oxygen, independently of the pressure of the oxygen in which it has been heated, provided that this pressure exceeds 0.005 mm. of mercury. As the pressure of the oxygen is diminished further, the activity of the treated metal falls rapidly, reaching a maximum when the oxygen pressure is 0.0013 mm. After silver has been heated to dull redness in oxygen at a pressure higher than 0.005 mm., it would seem to be covered with a thin film of silver oxide, which is a less powerful catalyst than the metal itself. Gold furnished similar but less pronounced results. In the presence of the film of silver which was formed on the surface of the glass during the experiments, hydrogen and oxygen will combine at the temperature of the laboratory.—U. R. Evans: The colours due to thin films on metals. Mallock has objected to the interference-theory of the colours on the grounds that he had failed to alter the colours of tempered iron by polishing the metal. It has now been shown that the colours can be changed when the thickness of the film is uniformly reduced by cathodic treatment in dilute hydrochloric acid. Raman has proposed that the colours are due to a granular structure; but the colours on molten lead can be obtained as easily when the oxide-film is molten as when it is solid, and thus the "granular theory" fails. The oxide-films have been lifted off molten lead, and examined, supported on glass; the colours by transmitted light are complementary to those by reflected light, as is to be expected on the interference view.—A. Campbell: On the determination of resistance in terms of mutual inductance. A new method of balancing mutual inductance against resistance is described, in which one of the conditions of balance is independent of frequency and can be set once for all, while the second condition gives a very simple relation between the frequency, two resistances and two mutual inductances.—S. Butterworth: On the alternating-current resistance of solenoidal coils. The general theory of eddy-current losses in cylindrical conductors is employed to establish formulæ for computing the alternating-current resistance of single-layer solenoidal coils. Two formulæ are obtained which are shown to be in reasonable agreement with observation, except when the frequency is extremely high. The formulæ should be applicable so long as the current may be regarded as having uniform distribution throughout the coil.—A. J. Allmand and V. S. Puri: The effect of superposed alternating current on the polarisable primary cell zinc—sulphuric acid—carbon. Part I.: Low-frequency current. Ten years ago Brown showed that, if an alternating current of either 100 or 12,000 periods and of suitable intensity were passed through the above primary cell, the polarisation of the latter was reduced and its current output increased. The experiments were repeated and extended, using alternating-current frequencies of 20 to 400 cycles per second, the potentials of the two electrodes being measured whilst the currents were running. The

results showed conclusively that, with such frequencies, the carbon electrode is chiefly responsible for the decreased polarisation and increased cell current The lower the frequency, the greater the effect At the same time there were certain indications that, with higher frequencies, an effect would be produced at the zinc electrode, as observed by Brown —R W **Lunt** The interaction of carbon dioxide and hydrogen in the corona due to alternating currents of high frequency Alternating electric fields of frequency $1 5 \times 10^7$ have been used An equimolecular mixture interacts, giving a water-gas equilibrium, which is also attained by exposing mixtures of carbon monoxide and water vapour to the discharge In no case has it been possible to detect the formation of formic acid or formaldehyde T **Royds**: The apparent tripling of certain lines in arc spectra. As many spectra as possible were searched through the visible region for instances of lines becoming complex when the amount of material in the arc was increased Only seven cases were found, all of which apparently become triple with a sufficient quantity of material The Tl line 5350 passes through five successive phases, namely, broad simple reversal, triplet, doublet, a second triplet form, and a final doublet, as the amount of material in the arc burns out This line is essentially a doublet, and all the different phases can be explained as different stages in the self-reversal of the two lines of the doublet A similar explanation was adopted for the six remaining instances of apparent tripling, as all except two were found to assume a doublet form as the final phase —E **Newbery** Over-voltage and transfer resistance.

Physical Society, December 12 —A C **Egerton** · Numerical values of chemical constants and frequencies of the elements The experimental evidence for the general chemical constant C_0 possessing the theoretical value ($-1 \cdot 589$) is collected A linear relation between logarithm of mass and characteristic temperature is indicated —J H **Powell** The sensibility of circular diaphragms for the reception of sounds in water The diaphragms were mounted with one face immersed in water and to the other was attached a microphonic or electro-magnetic detector They were all designed to have a frequency of 850~ under these conditions The response of the diaphragms to sounds of a single definite frequency was measured, and resonance curves were obtained from which the magnitude of the damping due to the detector was determined The corrected values for the resonance amplitude and for the persistence of vibration were consistent with those determined mathematically by Prof H Lamb for diaphragms under ideal conditions The investigation was extended successfully to cover complex sounds or "noises" of no definite pitch —A **Campbell** A direct-reading frequency meter of long range A direct-reading frequency meter for audio frequencies is described It is a null instrument, reading by single adjustment, the working system embodying a new method of balancing mutual inductance by resistance The standard type has five ranges, covering from 180 to 4000~ per second, with accuracy of the order of 1 in 1000, and negligible temperature coefficient except at the lowest frequencies

Linnean Society, January 8 —E S **Goodrich** On the cranial roofing-bones in the Dipnoi A general fundamental plan of the roofing-bones of the skull can be made out, to which conform the primitive Teleostomi and Tetrapoda The earliest fossil dipnoan, Dipterus, appears to possess the usual paired frontals and parietals (still more distinct in Scaumenacia), but Messrs Watson and Gill identify these as nasals and frontals, and believe the parietals to be represented by the median posterior occipital plate The bones in early Dipnoi conform to the general plan, but in the course of specialisation the paired frontals and parietals tend to become reduced in size, separated in the middle line, and more and more superseded by a series of median elements, of which the median occipital is the largest and most constant —C. C **Lacaita** (1) A note on *Colchicum montanum* Linn The name *Colchicum montanum* must be abandoned altogether It has generally been used for the Italian *C Bertolonii*, but *C. montanum* of Linn Sp Pl is a mixture of *Merendera Bulbocodium* with *Colchicum alpinuum*, while the specimen in herb Linn. is really *C Bulbocodium* from the eastern Mediterranean It was not sent to Linnæus by Loefling, for it does not grow in Spain, and the sheet is marked on the back "Habitat in Morea" The spring-flowering *C Bulbocodium*, with broader leaves and more nerves in the sepals, is a distinct species from *C Bertolonii* (2) Some critical species of Marrubium The Linnean diagnoses were written for Hort Cliff, and only repeated in Sp Pl Therefore H Cliff specimens and not those of herb Linn are decisive, except in the case of *M hispanicum* The Adriatic plant usually called *M candidissimum* is not that of Linnæus, and must bear the name of *M incanum* Desr. True *M candidissimum* Linn is a species from Asia Minor J C **Waller** On types of electric response in plants

DUBLIN

Royal Irish Academy, January 12 —H **Ryan** and J **Lennon** The condensation of aldehydes with methylethylketone: γ-benzylidene-methylethylketone condenses with benzaldehyde to yield isomethyldiphenylcyclopentenone, with anisaldehyde to yield 1-methyl-4-anisyl-5-phenyl-cyclo-penten(3)-one(2) and with piperonal to form 1-methyl-4-piperonyl-5-phenyl-cyclo-penten(3)-one(2). When isomethyldiphenylcyclopentenone is warmed with dilute alcoholic hydrochloric acid, it changes into methyldiphenylcyclopentenone This compound condensed with benzaldehyde to yield benzylidene-methyldiphenylcyclopentenone, which is identical with the tri-condensation product of benzaldehyde and methylethylketone obtained by Ryan and Devine. Anisaldehyde condensed with methylanisylphenylcyclopentenone to yield anisylidene-methylanisylphenylcyclopentenone, and the isomeric compound obtained by Ryan and Devine by the action of anisaldehyde on α-benzylidene-methylethylketone is anisylidene-methylphenylanisylcyclopentenone

CALCUTTA

Asiatic Society of Bengal, January 7 —Johan **van Manen** A collection of Tibetan proverbs More than 200 sayings have now been gathered —Sunder **Lal Hora** On the habits of a succineid mollusc from the Western Ghats In August 1924 a new species of Succinea was discovered hibernating on the bark of mango trees at Lonavla Several members of the family Succineidæ are known to tide over periods of draught by æstivating, but none have so far been recorded in a comatose condition during the rainy season Other members of this family have been found on rocks, but this is the first occasion when a succineid mollusc has been found hibernating on barks of trees

SYDNEY

Linnean Society of New South Wales, November 26 —H M **Hale** Two new Hemiptera from New South Wales Description of a new genus, from Berowra

Creek and Epping, belonging to the Notonectinæ, and a new species of Salda from Wentworth Falls.—W. A. **Haswell**: Critical notes on the Temnocephaloidea. A description is given of the female part of the reproductive apparatus in various species of Temnocephala from Australia, New Zealand, and South America. The relations of the vesicles variously known as receptacula seminis, receptacula vitelli, and vesiculæ resorbientes are described and their functions and homologies discussed.—P. **Brough**, J. **McLuckie**, and A. H. K. **Petrie**: An ecological study of the flora of Mt. Wilson. Pt. I. The vegetation of the basalt. The origin and distribution in Eastern Australia of the Malayan floristic elements are discussed, and an account is given of the structure, composition, inter-relationships, and distribution of the plant communities occupying the basalt caps at Mt. Wilson, the flora of which is largely composed of Malayan elements. A detailed study is made of the overlapping of the Malayan flora of the basalt, and the endemic flora of the adjacent sandstone.

WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol. 10, No. 11, November).—H. **Fricke** and O. **Glasser**: The secondary electrons produced by hard X-rays in light elements. The ionisation current was measured in ionisation chambers (0·5-9 c.c. in volume) constructed entirely of the material under examination, which are small in comparison with the path of the photo-electrons in the chamber. In these circumstances, the current can be represented, according to Compton's theory of scattering of X-rays, as the sum of two quantities, one of which is independent of the effective atomic number of the scattering substance. The ratio of these quantities is determined and agrees with that calculated, using Compton's theory, from other data, for two nearly homogeneous radiations.—C. **Barus**: The diffusion of hydrogen into air, measured by the interferometer U-gauge. Essentially, the method is to measure the pressure at the closed top end of a vertical tube while hydrogen diffuses from the open-bottom end. Using various tubes of different length and diameter, the diffusion constant is always considerably higher than the generally accepted value.—W. N. **Birchby**: White light interference fringes with a thick glass plate in one path. A glass plate is inserted in one of the paths of a Michelson interferometer. The fringes are alternately red and green, while the central fringes are indeterminate. For the central region the effect is due to interference in one narrow range of the spectrum superimposed on uniform illumination from the rest of the spectrum.—J. **Kendall** and J. F. **White**: The separation of isotopes by the ionic migration method. If isotopic ions have significant different mobilities, it should be possible to effect separation by electrolysis (NATURE, June 2, 1923, p. 763). Preliminary short runs were made in which it was found possible to effect separation of iodide and thiocyanate ions (16 per cent. mobility difference), barium and calcium ions (8 per cent. difference), barium and strontium ions (5 per cent. difference), and iodide and chloride (about 1 per cent.). A 5 cm. sodium chloride section (0.1 N) between sodium hydroxide and acetate was moved 1000-2000 cm. with inconclusive results. The tubes used, 1·5 in. wide, are not big enough to give segments suitable for ordinary analysis.—W. J. **Crozier**: On the possibility of identifying chemical processes in living matter. Chemical transformations proceed according to Arrhenius's equation, that the velocity of monomolecular change is proportional to the exponential of $-E/RT$, where R is the gas constant, T the absolute temperature, and E is the amount of heat required to convert 1 gm. molecule of the reactant from an inactive to a reactive form. E is thus characteristic of the reactant and, in simple chemical processes, of the catalyst. The velocities of many biological processes are influenced by temperature in a manner similar to ordinary chemical reactions, and the critical increments, or *temperature characteristics*, of the former fall into definite groups. Physiological transformations of a similar type give identical values for this constant suggesting the presence of similar catalytic agents (*not* enzymes). This points to the possibility of the identification of chemical transformations in undisturbed living matter.—R. L. **Moore**: Concerning sets of segments which cover a point set in the Vitali sense.—A. E. **Kennelly**: Time constants for engineering purposes in simple exponential transient phenomena.

Official Publications Received.

Publications of the Astronomical Institute of the University of Amsterdam. No. 1: Researches on the Structure of the Universe. 1. The Local Starsystem deduced from the Durchmusterung Catalogues. By A. Pannekoek. Pp. ii+122+6 charts. (Amsterdam: Stadsdrukkerij.)

Europe as an Emigrant-exporting Continent and the United States as an Immigrant receiving Nation. Hearings before the Committee on Immigration and Naturalization, House of Representatives, Sixty-eighth Congress, First Session, March 8, 1924. Serial 5-A. Statement of Dr. Harry H. Laughlin. With Appendices printed by Authorization of the Committee, including (1) Text of Immigration Act of 1924 and the Proclamation of the President in connection therewith, (2) Report of the Rome Conference on Emigration and Immigration, and (3) Other important Studies and Official Reports on Migration Problems down to November 19, 1924. Pp. v+1231-1437. (Washington: Government Printing Office.)

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Havsforskningsinstitutets Skrift. No. 17: Wasserstandsregistrierungen in Helingsfors 1904-1920. Von Henrik Renquist. Pp. 75+3 plates. 15 Fmk. No. 19: Dagliga vattenståndsuppgifter 1921. Referat: Tägliche Wasserstandsangaben 1921. Av Henrik Renquist. Pp. 30. 3 Fmk. No. 20: Regelbundna iakttagelser av havets temperatur och salthalt under år 1921. Referat: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1921. Av Gunnar Granquist. Pp. 54. 6 Fmk. No. 22: Isarna vintern 1920-21. Referat: Das Meereis im Winter 1920-21. Av Gunnar Granquist. Pp. 79+11 plates. 30 Fmk. No. 24: Ström- och vindobservationer vid fyrskeppen år 1922. Referat: Strom- und Windbeobachtungen an den Leuchtschiffen im Jahre 1922. Av Gunnar Granquist. Pp. 40. 4 Fmk. No. 25: Havsforskningsinstitutets verksamhet under år 1922. Av Rolf Witting. Pp. 25. 3 Fmk. No. 26: Regelbundna iakttagelser av havets temperatur och salthalt under år 1922. Referat: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1922. Av Gunnar Granquist. Pp. 58. 6 Fmk. No. 27: Talassologiska varexpeditionen 1923. Referat: Die thalassologische Terminfahrt im Jahre 1923. Av Risto Jurva. Pp. 28+1 plate. 4 Fmk. No. 29: Dagliga vattenståndsuppgifter 1922. Referat: Tägliche Wasserstandsangaben 1922. Av Henrik Renquist. Pp. 44. 7 Fmk. No. 31: Havsforskningsinstitutet verksamhet under år 1923. Av Rolf Witting. Pp. 25. 4 Fmk. (Helsingfors.)

A Short Account of the Growth of the University of Leeds. Pp. 31. (Leeds.)

Leeds University: General Prospectus. Jubilee edition. Pp. 47+6 plates. (Leeds.)

Diary of Societies.

MONDAY, FEBRUARY 2.

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4.30.

ROYAL INSTITUTION OF GREAT BRITAIN (General Meeting), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Z. Cope: Extravasation of Bile.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—A. S. Buckle: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Plymouth), at 6 —H Marryat · Electric Passenger Lifts.
INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7 15 —G Rogers Automatic and Semi-Automatic Mercury Vapour Rectifier Substations
JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St Mary's Parsonage, Manchester), at 7 15 —G B Walker The Design and Construction of a Piano Player
ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street, W C), at 8 —Prof G H Langley Values and Temporal Experience
ROYAL SOCIETY OF ARTS, at 8 —V E Pullen Radiological Research—a History (III) (Cantor Lectures)
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —E J Lush Kinetics of Hydrogenation —C O Condrup and E W Smith Tar Distillation by means of the T I C (Lead Bath) Process
INSTITUTE OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club), at 8 —W G Martin The Calender in the Rubber Industry
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 30 —President's Address and Presentation of Prizes

TUESDAY, FEBRUARY 3

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr H R Hall The Connexion and Relations of the Prehistoric Greek and Ancient Egyptian Civilisations (II)
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 5 30 —Prof W L Bragg (a) Model illustrating the Formation of Crystals, (b) Exhibit of Diffraction Gratings constructed to illustrate the Effect of Crystals on X Rays —R W James The Structure of Barium Sulphate —Dr E C S Dickson The Flettner Rotor Sail
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30 —Dr H I Waterman and J N J Perquin Decomposition of Paraffin Wax at 450° C in Presence and in Absence of Hydrogen under High Pressure
ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Secretary Report on the Additions to the Society's Menagerie during the months of November and December 1924 —G C Robson Exhibition of a Giant Squid (*Stenoteuthis caroli*) recently stranded on the Yorkshire Coast —M S Mackinlay The Language of the Emotions Universal Methods of Expression —Dr N S Lucas Ill-health in Captive Wild Animals and its Causes —Prof O Fuhrmann and Dr Jean G Baer Zoological Results of the Third Tanganyika Expedition conducted by Dr W A Cunnington, F Z S, 1904–1905 —Report on the Cestoda —Doris R Crofts The Comparative Morphology of the Cæcal Gland (Rectal Gland) of Selachian Fishes —S Hirst Descriptions of New Acari, mainly parasitic on Rodents
INSTITUTE OF MARINE ENGINEERS, at 6 30 —W B Lewis and G S Irving The Treatment of Boiler Feed Water
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7 —A B Mallinson and others Discussion on Justifiable Small Power Plants
INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7 —Discussion on Metal Melting.
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Section) (at Broadgate Café, Coventry), at 7 15
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7 15 —Dr T Slater Price The Action of Light on the Photographic Plate —J I Graham and F Lawrence The Use of Iodine Pentoxide in the Estimation of Carbon Monoxide
INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-on-Tyne), at 7 30
RÖNTGEN SOCIETY (at British Institute of Radiology, 32 Welbeck Street, W), at 8 15 —Major C E S Phillips Constant Voltage High Tension Generators —C H Holbeach (a) Some Further Aspects of the Theory and Operation of Potter-Bucky Diaphragms, (b) Demonstration of the New C D.X Dental X-Ray Equipment

WEDNESDAY, FEBRUARY 4

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof H P W White The Pathology of Hydronephrosis
GEOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr A Heard The Petrology of the District between Nevin and Clynnog fawr (Carnarvonshire)
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6 —L B Turner and F P Best The Optimum Damping in the Auditive Reception of Wireless Telegraph Signals
ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7 30
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8 —Presidential Address —(Ordinary Meeting) —Dr D Hooper Cinchonine as a Tannin Precipitant with Special Reference to the Analysis of Cutch and Gambier —C Ainsworth Mitchell The Examination of Charred Documents —H R Ambler The Absorption of Carbon Monoxide in Gas Analysis
ROYAL SOCIETY OF ARTS, at 8 —Sir Ernest Rutherford The Stability of Atoms (Trueman Wood Lecture)
ENTOMOLOGICAL SOCIETY OF LONDON, at 8
ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, Anæsthetics, Pathology, Obstetrics and Gynæcology Sections), at 8 —Sir Charles Gordon-Watson, E C Lindsay, and others Special Discussion on The Prevention and Treatment of Post-Operative Pulmonary Affections

THURSDAY, FEBRUARY 5

ROYAL SOCIETY, at 4 30 —H M Carleton Growth, Phagocytosis and other Phenomena in Tissue Cultures of Fœtal and Adult Lung —F W. Fox and J A Gardner The Origin and Destiny of Cholesterol in the Animal Organism Part XIV The Cholesterol Metabolism in Normal Breast fed Infants —H H Thomas The Caytoniales A new Group of Angiospermous Plants from the Jurassic Rocks of Yorkshire —Dr Winifred Brenchley and H G Thornton The Relation between the Development, Structure, and Functioning of the Nodules on *Vicia Faba* as influenced by the Presence or Absence of Boron in the Nutrient Medium —*To be read in title only* —A S Rau, F W. R. Brambell, and Prof J B Gatenby Observations on the Golgi Bodies in the Living Cell —V Nath Cell Inclusions in the Oogenesis of Scorpions —L J Harris The Combination of Proteins, Amino-Acids, etc with Acids and Alkalis and their Combining Weights, as determined by Physico Chemical Measurements
LINNEAN SOCIETY OF LONDON, at 5 —Dr G P Bidder Growth and Death. a Discussion —Dr J Burtt Davy The Geographical Distribution of the Arborescent Vegetation of Subtropical South Africa
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg The Properties and Structure of Quartz (II)
ROYAL AERONAUTICAL SOCIETY, at 5 30 —Air Commodore C R Samson The Operation of Flying Boats in the Mediterranean
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6 —Mrs V Plincke The Waldorf School, Stuttgart
INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —Dr J H Jeans Electrical Forces and Quanta (Kelvin Lecture)
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7 30 —P G J Gueterbock Tin
CHEMICAL SOCIETY, at 8
SOCIETY OF DYERS AND COLOURISTS (West Riding Section) —Prof H E Armstrong Colour Problems
INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Meeting) —J Biggam Methods of Determining the Properties of Steam
INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Meeting)

FRIDAY, FEBRUARY 6

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30 —J T Marten The Indian Census
ROYAL DUBLIN SOCIETY, at 4 30
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof A H Todd Syphilitic Arthritis
INSTITUTION OF MECHANICAL ENGINEERS, at 6 —J B Dahlerus Anti-Friction Bearing Applications for Heavy Duty
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St Mary's Parsonage, Manchester), at 7 —Dr T Callan The Detection and Determination of Alpha Naphthol in Beta-Naphthol —W J S Naunton Some Organic Rubber Vulcanising Accelerators
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7
JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —E G Herbert The Measurement of Hardness and Allied Properties of Metals
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 —H Smith Constructional Work
PHILOLOGICAL SOCIETY (at University College), at 8 —N W Thomas The Sudanic Languages
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof R W Chambers The Earliest Recorded Kings of the English

SATURDAY, FEBRUARY 7

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C), at 3 —Dr J R Leeson The Evolution of Man
ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Dr E H Fellowes The Elizabethan Ayre

PUBLIC LECTURES.

SATURDAY, JANUARY 31.

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Miss M A Murray The Empire of Egypt

MONDAY, FEBRUARY 2

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —Dr E B Behrens International Labour Organisation
BIRKBECK COLLEGE, at 5 30 —Dr G G Coulton Medieval Education (I) The Monastic School

TUESDAY, FEBRUARY 3

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5 —E C Dodds Chemistry of the Internal Secretions (Succeeding Lectures on February 5, 10, 12, 17, 19, 26, and March 3)
UNIVERSITY COLLEGE, at 5 30—W J Perry The Beginnings of Civilisation —W H Baynes Some Aspects of Byzantine Civilisation (I) Constantinople (Succeeding Lectures on February 10, 17, 24)
KING'S COLLEGE, at 5 30 —Miss Hilda D Oakeley The Religious Ideas of Plato
GRESHAM COLLEGE, at 6 —A. R. Hinks Our Place in the Universe (Succeeding Lectures on February 4, 5, 6)
UNIVERSITY OF LEEDS, at 8 —Dr W H Pearsall Woodlands and Moorlands in Yorkshire

WEDNESDAY, FEBRUARY 4

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —H P Shapland The Principles of Design as applied to Furniture
KING'S COLLEGE, at 5 30 —Prof A Mawer The Viking Age, A D 800–1000
UNIVERSITY COLLEGE, at 5 30 —R E Flower The Use of Libraries (II) Collections and Manuscripts

THURSDAY, FEBRUARY 5.

BIRKBECK COLLEGE, at 5 30 —Prof E N. da C Andrade The Structure of the Atom (I) (Succeeding Lectures on February 12, 19)
KING'S COLLEGE, at 5 30 —Lt-Commdr A S E Sutton The Civilisation of China General View

FRIDAY, FEBRUARY 6

UNIVERSITY OF LEEDS AND LEEDS PHILOSOPHICAL AND LITERARY SOCIETY (at Philosophical Hall, Leeds), at 8 —Prof J Garstang The Archæology of Palestine

SATURDAY, FEBRUARY 7

HORNIMAN MUSEUM (Forest Hill), at 3 30 —R P G Denman The Development of Modern Radio Communication

SATURDAY, FEBRUARY 7, 1925.

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Editorial and Publishing Offices
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The Future of the British Patent Office.

THE British patent system is a matter which concerns all workers in applied science, for it represents an attempt—faulty and incomplete, but still an attempt—to secure for such workers the credit for their achievements, together with a share of the material advantages arising from these Hence any event which seriously affects the future of the patent system is one to which the scientific world should give careful consideration, and such an event is just beginning to appear on the horizon Lest it should take shape before its implications have been seriously canvassed, it may be well to direct attention to some of its aspects There is a rule which requires Government servants to submit to superannuation at an age when many men are still capable of their best work, and since the rule appears to be inexorably applied, the retirement of the present Comptroller of the Patent Office and the appointment of his successor must be regarded as inevitable in the not very distant future. It is perhaps a little early to discuss this question, but not too early, for when the first official intimation of such a change is given, the selection of the successor may be actually, if not formally, a *fait accompli*

That a scientific office should have a scientific man at its head is a principle which seems obvious but needs to be constantly reasserted, because the administrative officials who influence such appointments are not always sympathetic towards the claims of science. In fact, a lack of sympathy in that direction is sometimes manifested to a degree which exposes it to strong criticism, as in the proceedings of committees A, B, and C of the National Whitley Council, and in the general tendency to regard the man of science as a mere adviser who is himself incapable of administrative work Such an attitude is the more unjustifiable from the fact that a scientific training is necessarily always *additional* to some degree of education in the humanities, whereas a literary scholar may be quite ignorant of science; so that the former type of upbringing is the more likely to produce the breadth of outlook which is necessary in handling men and affairs.

Taking the British Patent Office as an example, let us examine the qualifications which are necessary in the man who is to direct its labours The duties of the Comptroller fall under three heads as follows :

(1) He is the senior Hearing Officer for disputes as to patents, trade marks, and designs He has to adjudicate in "oppositions" brought by interested parties against the grant of particular patents, as well as in cases where examiner and applicant fail to agree in regard to the official requirements put forward by

the former Thus the Comptroller is a court of first instance for certain classes of patent litigation, and although he delegates this duty in a proportion of cases to subordinate Hearing Officers drawn from the examining staff, in the remaining cases he acts personally For the adequate discharge of this function, the importance of which is obvious, the Comptroller should have legal knowledge, experience of patent practice, and such a wide training in scientific matters as to be able readily to appreciate, in the structure and functioning of electrical, mechanical, and chemical systems, those details and subtleties around which patent litigation so frequently turns Should he lack the latter qualification, the new Comptroller would in many instances be thrown on the mercy of his advisers from the examining staff, and so would relinquish both his dignity and, in the case of disagreement between examiner and applicant, his judicial neutrality

(2) He will command the staff of the Patent Office, in addition to those of the Trade Marks and Designs Branches. The essential work of the Patent Office is carried on by the examining staff, comprising (according to the last Annual Report) more than 250 men having the necessary scientific qualifications, while the routine incidental to their labours necessitates a supplementary staff comprising roughly an equal number of clerical workers It would be unreasonable to subordinate the examining staff, in the years that lie ahead, to the control of a man who is not qualified, by a scientific training similar to theirs, to understand the outlook and the mentality with which such training is associated It must be remembered that fundamental changes in the relative importance of the scientific and clerical sections of the staff have followed the changes introduced into the patent system by the Act of 1907

(3) The new Comptroller will be called upon to advise the government of the day with regard to the improvement and extension of the patent system, which has certain unsatisfactory features, the chief being its incompleteness It is incomplete because the official search is arbitrarily limited to British specifications, because it is imperfectly co-ordinated with other patent systems throughout the British Empire, and because adequate use is not made, for the benefit of national and industrial technology, of the special knowledge acquired by the examining staff (though the latter criticism does not apply to the War period, when many of the staff were drafted to the Ministry of Munitions) In the reconstruction of the Patent Acts the new Comptroller will play a pivotal part, and it is desirable, therefore, that he should have first-hand knowledge of the way in which the present system has worked in practice Equally must he be a man of broad views and open mind, gifted with that sense of proportion and that *flair* for actualities which characterise the thinking of the quantitative and experimental sciences.

Where, it may be asked, is it possible to find a candidate possessing the necessary legal knowledge, scientific training, experience of patent practice, and largeness of outlook? Three classes of men immediately suggest themselves (1) The patent bar, (2) the patent agents, and (3) the examining staff of the Patent Office itself There are difficulties to be encountered in each case. As regards the third group, it is not the general practice of the Treasury to put at the head of a department a man promoted from within it, and we do not know in what circumstances exceptions to this rule are considered feasible If the Comptrollership should be filled from within the Board of Trade, technical and not purely administrative attainments should decide the appointment. As regards the other two classes, the difficulty is that successful patent barristers and successful patent agents are able to make incomes many times greater than the salary attached to the Comptrollership The dignity of the office might *perhaps* combine with the opportunity of public service which it offers to attract a man of the necessary calibre, but there is a fairer and wiser way to meet the difficulty in question. That way is, to raise the salary of the post to a level commensurate with the importance of the latter

The public interest would suffer if the new Comptroller were to be a man whose lack of the requisite qualifications was only compensated by the possession of influential friends Particularly would it be undesirable to fill such a post by promotion from the "administrative" or clerical grades of the Civil Service There is a right place in the scheme of things for the bureaucratic mentality, but that place is not at the head of the Patent Office While it is true that the business of the State could not be carried on without the meticulous observance of precedent, the mastery of complicated routine, the punctilio of official etiquette which are the special merits of the clerical civil servant, it is equally true that such gifts are not adequate to enlist the confidence of subordinates and of the public on behalf of the chief of a technical office already over-ripe for innovation and development

Whatever decision may be taken when the time comes, it is earnestly to be hoped that no candidate will even be considered who does not combine with experience of patent practice a thorough training in physical science. It should be an absolutely inviolable principle that an essentially scientific staff should have a man of science at its head.

The Imperial College of Tropical Agriculture.

AT a luncheon at the Mansion House on January 29, given by the Lord Mayor of London and the governing body of the Imperial College of Tropical Agriculture, which is now getting into the swing of its work in Trinidad, Lord Milner's recent appeal for more funds for the endowment of the College was supported by a number of speeches which are of good augury for the future of scientific work in the British tropical colonies

The Secretary of State for the Colonies (Mr Amery), in proposing the toast of the College, said that it is an enterprise that holds out great hope in regard to the development of that great imperial asset, the tropical colonies. It is in this light that one should regard it—not as a local affair in Trinidad, but as an Imperial institution, the work of which will have a most important bearing upon the progress of our great tropical Empire. This has been much neglected in the past, though it has contributed so much to the wealth of the mother country—through sugar in the West Indies, coffee, coconuts, and tea in India and Ceylon, rubber in Malaya and Ceylon, jute, rice, and many other commodities in India.

From the wetter parts of our tropical possessions we obtain most of our supplies of cacao, cinchona bark for quinine, coconuts and their oil (for soap), copra, coir fibre, coffee, guttapercha, jute (for gunny bags), palm oil (for soap and lubricants), palm fibre (for brushes), rice, rubber, sago, spices, sugar, tea, tapioca, and many fruits, including the banana, and from the drier parts we obtain much tobacco and other products Tropical Africa now bids fair to go far towards supplying Great Britain with cotton.

Such being the case, one might expect to find much money spent upon the development of the tropical colonies and everything connected with them (especially matters concerned with agriculture and its teaching) In actual fact, their development has largely been effected out of their own revenues, which are in general modest, as they depend mainly upon agriculture An important departure from this method has recently been made, and the home Government has advanced a large loan to some of the tropical African colonies, with the express object of enabling a rapid development of their systems of transport

With the great competitive extension of planting and of agriculture generally that is now going on in the tropics, the lack of appreciation of the importance of such an institution as the Imperial College must be due to want of thought. Surely this only needs to be pointed out for some of our wealthy firms and individuals, who have won prosperity from the great industries of rubber, tea, coffee, cotton, coconuts, and other products of the tropics, to come forward with important contributions towards the 100,000*l* for which Lord Milner has appealed—an endowment to enable the College to make proper use of its great opportunities.

Let it be always remembered that the College is the Imperial College of Tropical Agriculture, and that it is to train men not for Trinidad alone, but for all the widely flung tropical dependencies of the British Empire It has already received some munificent endowments, but is in need of many more Its land and its largest cash endowment it owes to the Government of Trinidad It has received machinery to the value of 20,000*l* from the British Sugar Machinery Manufacturers, and has erected a model sugar factory Messrs Davidson and Todd, of Port of Spain, have presented the furniture, made of local woods, for the main hall of the College. Equipments for rubber, tea, cotton, and others are equally to be desired, and expert staffs are needed to manage them

That important organisations are placing faith in the future value of the College is seen from the fact that the Empire Cotton Growing Corporation, with an executive council composed mainly of Lancashire business men, is sending many of its students to be trained there These men will have in their hands the chief part in the development of this great industry within the British Empire

One of the greatest desiderata in the proper opening up of our tropical possessions is a due care for health, and in this connexion it was of great interest to learn from the speech of Sir Arthur Shipley (chairman of the governors) that "the Trustees of the International Health Board (who control the Rockefeller endowments), after careful inquiry into the efficiency and standing of the College, have offered 1000*l*. a year for five years to establish a professorship of tropical sanitation and hygiene", and if this proves a success, Sir Arthur has no doubt that they will continue their benefaction This still further emphasises the need of the institution for further endowment and equipment

With the opening of the Imperial College, the older methods of rule of thumb will tend to disappear in the light of modern scientific study, as they have all but disappeared in medicine or surgery The chance for the young men of to-day, as against their predecessors of thirty years ago, is brighter to an almost incredible degree, provided that men of as good and as capable a type are ready to take advantage of it Let us wish all prosperity to the Imperial College of Tropical Agriculture under the capable guidance of Dr Hugh Martin Leake, its new principal, who has lately succeeded to the great pioneer of its fortunes, Sir Francis Watts.

Reminiscences of Great Naturalists.

Impressions of Great Naturalists Reminiscences of Darwin, Huxley, Balfour, Cope, and others By Prof. Henry Fairfield Osborn. Pp xxviii+216+12 plates. (New York and London · Charles Scribner's Sons, 1924) 12*s* 6*d* net

PROF HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, distinguished especially for his palæontological researches, was one of Huxley's students and he also worked under Francis Balfour He met Darwin and corresponded with Wallace, he was friendly with the combative Cope and very intimate with Roosevelt So he has given us his impressions of these and others, selecting a dozen out of the fifty-seven "appreciations" which he has written in the course of his busy life He has indulged his liking for trying to sum people up; and he has cultivated the gift, he tells us, by studies in heredity and racial characteristics and our ancestors of the Old Stone Age For with his studies there has grown the conviction that "our intellectual, moral, and spiritual reactions are extremely ancient, and that they have been built up not in hundreds but in thousands—perhaps hundreds of thousands—of years" This palæontographical line of thought is very suggestive; thus we think of Pasteur as the supreme avatar of the tanners, and of Roosevelt as the glorification of the hunters; but we do not find that Prof. Osborn has allowed it much expression in his book, unless in "the racial soul of John Burroughs"

We suspect that the greater part of the success of Prof Osborn's pictures is due not to any theoretical background, but simply to the fact that he is a large-hearted, open-minded, big-brained naturalist himself, a generous rather than critical painter, who instinctively looks for what is best in his sitters If we ever rise to having our portrait painted, we shall hope to have it done by Prof Osborn But they allow you little say in such matters Here, however, is a truly delightful book of impressions, marked by insight, balanced judgment, and humour

Wallace's portrait must always be difficult, he was so unequal with a passion for truth-seeking, yet led astray by will-o'-the-wisps, an observer of the highest rank, yet wasting time in trying to prove to fools that the earth is not flat, a serious ponderer over the mysteries of life, yet often far from clear-cut in his thinking—say, over sex-selection or the possible origin of man's musical talents. One of the noblest men we ever met, one of the foundation-layers of modern biology, yet least wise, we think, when he differed most from Darwin. But the immediate point is that Prof Osborn gives us a beautiful picture of this great servant of the truth

Osborn was dissecting a lobster in Huxley's laboratory when Darwin came along and gave him a friendly greeting "He stands much taller than Huxley, has a very ruddy face, with benevolent blue eyes and overhanging eyebrows My general impression of his face is very pleasant" He had the eyes of "a man who could survey all nature." Perhaps this last sentence gets to the heart of the matter. Darwin's greatest gift was his capacity for unified vision, for seeing things whole He could take in such a comprehensive landscape that the fallacy of partial views was escaped Doggedly, as he says, he gathered his facts until their multitude would have overwhelmed most men, gathered them and gazed at them and tested them, until the ever-lurking generalisation took the form that fitted and made them one Whoever has come near Darwin in the all-round comprehensiveness of his picture of the struggle for existence, the inter-relations of organisms, or the processes of selection? The reason why he remains, on the whole, so sound is given by Osborn "His eyes were the eyes of a man who could survey all nature" He speaks also of their "translucent truthfulness," and in his palæontographical vein he refers to the fact that Darwin came of "a long line of compellingly truthful ancestors" As we expected, Osborn gives a robust answer to the question: How stands it with Darwinism to-day? He indicates the developments of Darwinism that are in progress, including, of course, some corrections, but his general view is that Darwinism is going on and going strong. We do not, however, agree that Darwin's supreme service was that "he won for man absolute freedom in the study of the laws of nature," for that halo belongs to no single emancipator

Prof Osborn is at his best in painting Huxley. He brings out his lucidity, his fighting qualities, his loyalty as "Darwin's bull-dog," his powers of brilliant generalisation, his capacity for taking pains, his passion for veracity Huxley's discernment of affinities has left many a deep mark on zoology. Here were steps of generalising insight of the highest order, and yet "he never contributed a single original or novel idea" to the Darwinian theory Prof Osborn regards this as an expression of Huxley's scientific caution—he could not make up his mind to an ætiology (to use his own word), but perhaps it simply meant that his originality and synthetic power found in morphology and taxonomy all the expression that his busy life would allow

Francis Maitland Balfour was "the most brilliant and lovable of men," "by far the most balanced mind

among all the English biologists", he set comparative embryology on its feet But the picture that is given of him is not more than an elusive sketch There is more body in the contrasted pictures of Joseph Leidy and Edward Drinker Cope, "the very last representatives in America of the older school of naturalists and anatomists, who covered a very broad field" Leidy was essentially a man of peace, Cope a militant palæontologist Leidy was an exact observer—a Cuvierian, Cope revelled in speculation, with the strands of Lamarck in his intellectual fabric. Leidy was an evolutionist *sub rosa*; Cope radiated evolution from his eyes

It is very interesting to see how impartially enthusiastic Osborn is in portraying the divergent excellencies of his old friends. His book contains some good stories, and here is one about Cope. A difference of opinion with his friend Persifor Frazer at the American Philosophical Society "led to such a violent controversy that the two scientists retired to the hallway and came to blows! On the following morning I happened to meet Cope and could not help remarking on a blackened eye 'Osborn,' he said, 'don't look at my eye If you think my eye is black, you ought to see Frazer this morning!'" We begin to understand better why Osborn insists that we must go back to the Old Stone Age if we are to understand one another. We are glad to be assured, however, that such differences of opinion did not sever the lifelong friendship.

We wish we had left room to speak of the other portraits of Roosevelt, with his suggestion of tremendous grip—we remember his hand-shake still—and his accurate knowledge of birds and mammals; of James Bryce, keen botanist and geologist, as well as mountain-climber and historian, who died young at eighty-three; of Howard Crosby Butler, the archæological explorer, of John Burroughs and of John Muir (we are ashamed to confess that we never heard of him before), and of Louis Pasteur, who "showed the way to the physical redemption of man, as Newton had opened to us the new heavens and Darwin the new earth" He should stand as "a symbol of the profound and intimate relation which must develop between the study of nature and the religious life of man" Prof Osborn's portraits are accompanied by very interesting photographs, and the two series throw light on one another. It is one of the most interesting books we have read for some time, provoking reflection, as well as pride and humility Our only serious criticism is the author's tendency to be too generous After all, was there a real genius amongst them—we mean a maker of new knowledge that makes all things new? No doubt Charles Darwin discovered a New World, but there were explorers before him as well as before Columbus, and the doctrine of evolution was not created at Down. They were giants these men here portrayed, but, seriously, when we think of it, would we compare any of them intellectually to Newton or Faraday, to Clerk Maxwell or Kelvin? We doubt if biological science has in the past enthralled any minds of the first order of magnitude, except men like Aristotle, Descartes, and Goethe, who could do everything well. So while Osborn asks if we could nurture a mind like Darwin's to-day, and is inclined to answer in a sad negative, our impression is that we may not unreasonably hope to nurture something even better

J ARTHUR THOMSON.

Modern Views on Cytology.

General Cytology a Textbook of Cellular Structure and Function for Students of Biology and Medicine. By Robert Chambers, Edwin G. Conklin, Edmund V. Cowdry, Merle H. Jacobs, Ernest E. Just, Margaret R Lewis, Warren H. Lewis, Frank R. Lillie, Ralph S. Lillie, Clarence E. McClung, Albert P. Mathews, Thomas H Morgan, Edmund B Wilson. Edited by Edmund V. Cowdry. Pp. vii+754 (Chicago: University of Chicago Press, London: Cambridge University Press, 1924) 7 50 dollars

THIS volume—the largest and most comprehensive ever published on the subject of cytology—will stand for many years to come as the most authoritative exposition of a branch of zoology which has grown considerably in recent years. It has been written by the foremost cytologists in the United States of America, altogether thirteen workers, eminent in their special branch, having collaborated. The task of editorship was discharged by E. V. Cowdry.

Such a work could not have been written by one man, and it is obvious that no one reviewer can do justice to such a monument of learning The present reviewer is keenly aware of this, and would have wished, had it been possible, to have had a sectional review, assisted by English cytologists such as Ward Cutler, Agar, Gray, Ruggles Gates, and Heslop Harrison

Prof A P Mathews in his section discusses "Chemistry and Psychism," and comes to the conclusion that the creation of life is the creation of the "anakinetomeric form," *i e* energy-rich type of substance. Prof. Mathews writes

"It is in fact the luminiferous ether which has made things alive, for ether is the great storehouse of energy; it is itself nothing else than space and time; energy and time Energy is but ether divided by time Quantity of energy is quantity of ether per second. So all goes back to the ether; infinity and eternity. From it is derived our energy and life."

It is impossible for a working cytologist adequately to comment on such passages. They may mean something to the metaphysician, but one cannot help feeling that Prof Mathews' views on the relationship between cell lipins and cell proteins, or on the biochemistry of development, would have been more useful

The biochemist writing on the subject of the chromosome theory is always interesting. Prof. Mathews plainly, if cautiously, states that it would be difficult for the biochemist to accept the factorial hypothesis on the evidence of chemical analyses of the chromatinic heads of spermatozoa and other nuclei He points out that it is very improbable that were the chromosomes constituted of widely different genes, they would show so simple and definite a composition.

This is precisely where modern biochemistry fails: it has not kept up with either genetics or descriptive cytology, and probably never will until microchemical methods are more extensively developed. The statement made by Prof Mathews that the spermatid nucleolus disappears during spermateleosis is without doubt incorrect What happens is that the nucleolar and chromatinic substances come to stain with equal intensity.

M. H Jacobs contributes a section on the permeability of the cell to diffusing substances he deals especially with the modern work on intravital staining, and the penetrating powers of various salts and organic compounds This article should be of the greatest value to cytologists working with *intra vitam* methods, and the part dealing with the subject of dyes, if short, is particularly pertinent this chapter, as also many others in this book, shows clearly how indeterminate has been a great deal of recent experimental work. The modern zoological experimenter seems able to produce published papers more quickly than any other of his fellow zoologists, such work, carried on without a proper knowledge of the chemical and physical factors involved, is worse than useless Jacobs' article shows that there is still a great field for examination in cell permeability, but the searcher *must* be properly equipped. Jacobs refers often to the "Donnan equilibrium"

It would be difficult to set proper boundaries to the subject of the reactivity of the cell Naturally Ralph S. Lillie's section on this subject is somewhat diffuse and deals with much of his well-known work on the transmission of impulses by protoplasm, and especially with the transmission of nerve impulses As has been remarked with regard to Jacobs' section, this part by Lillie will certainly be of value to cytologists interested in intravital work, and to protozoologists The basic work on the irritability of plants, such as that of U Ricca, R. Snow, and H. H. Dixon, is not mentioned.

The editor of the volume, E. V Cowdry, has written a section on the mitochondria, Golgi apparatus, and chromidial substance. The article is well balanced if a little histological the contributions of the English workers on the cytoplasmic inclusions in gametogenesis are adequately mentioned, though the whole question of gametogenesis itself is untouched. This can be forgiven in view of the splendid treatment of the pathological side of this important branch of cytology. So much of our meagre knowledge of the function of the cytoplasmic inclusions has been ascertained by studies on gametogenesis, that it seems a pity that Dr Cowdry did not include a full treatment of the subject Some of the controversies regarding the inclusions in gametogenesis would surely have been settled had so distinguished a worker as Cowdry seen fit to enter into the field

The much-abused Golgi apparatus has at last received official recognition For this the reviewer at least is thankful Cowdry mentions that the Golgi apparatus does not occur in non-nucleated red blood corpuscles. it occurs in the red blood corpuscles of reptiles and birds, as has recently been shown With the possible exception of certain Protozoa, the Golgi bodies have been found in all nucleated animal cells at some time in their life-history

Warren Lewis and Margaret Lewis are so well known for their work in tissue cultures, that one would be led to expect an authoritative account on this subject, nor are we disappointed This section contains the best photomicrographs of cells published anywhere. Champy's interesting claims with regard to dedifferentiation of cells cultivated *in vitro* are not substantiated by the Lewises.

The most interesting recent discovery with regard to fertilisation is the process as it occurs in the sponge Grantia. Here somatic cells are entered, and the spermatozoon swells up and becomes spherical before it is finally carried to the egg These facts are not mentioned in Lillie and Just's section on fertilisation, nor are the peculiar examples of precocious fertilisation reviewed The entry of the somatic cells in sponges, mammals, and leeches by spermatozoa is not dealt with, this is a pity, because these facts have a very direct bearing on Lillie's fertilisation theory. The more physical side of fertilisation is adequately treated, but the article as a whole suffers from the fact that the authors have not dealt properly with the work of descriptive cytologists such as Jenkinson on the axolotl

Conklin contributes a suggestive section on cellular differentiation Some of the continental work on histogenesis, mentioned in NATURE, February 23, 1924, pp 276-278, has not come up for review, and the physio-

logical aspect is not dealt with, cell-lineage, a branch of cytology inseparably coupled with Conklin's name, is naturally treated exhaustively To explain the old question of cellular differentiation, Conklin assumes the presence of differential factors of development lying outside the nucleus, such areas being themselves the immediate result of the interaction of the cytoplasm of the nucleus at an earlier stage Such an assumption certainly explains partly some forms of development, but not all, and the main question is still unanswered

In the last two chapters we have an account by McClung of the modern aspects of the chromosome theory, and another section by Morgan dealing with his wonderful work on Mendelian heredity The recent English work on sex-reversal and the so-called suppression of the sex-chromosome is not properly dealt with, and should be included in the next edition

Some of the sections gain, others suffer, from the personal theories of the authors On the whole, the bibliographies are as complete as could be desired, and the illustrations are a feature of the work The book begins with an introduction by E. B Wilson, the best-known living cytologist, whose work on "The Cell" has been the students' standby for so many years In a footnote, Prof. Wilson mentions that he is bringing out a new edition of his work "General Cytology" is a splendid testimony to the high standard of American science, and cytologists on the eastern side of the Atlantic should be full of admiration and properly grateful for such a splendid volume

J. BRONTE GATENBY

General Chemistry.

(1) *Introduction to General Chemistry* By Prof William Foster. Pp vii + 643 + 29 plates (Princeton. Princeton University Press, London: Oxford University Press, 1924) 17*s.* 6*d* net

(2) *A Laboratory Manual in General Chemistry.* By Prof William Foster Pp ix+205 (Princeton. Princeton University Press; London Oxford University Press, 1924) 10*s.* net

(1) PROF FOSTER'S volume was printed in an experimental form two years ago and used by nearly 1000 students before being finally revised for publication It is a very crowded volume, but at the end of each chapter there are references to the sources of the material, which the student is recommended to read for fuller information It is no small compliment to English authors that the books cited for this purpose are in the great majority of cases the standard works used in Great Britain. This statement applies, not only to the larger text-books, such as those of Roscoe and Schorlemmer, of Mellor and of Friend, the first of which must have provided the materials for scores of smaller works, but still more frequently to the recent single-volume text-books of Lowry and of Partington, which are repeatedly cited in this way

The chief fault of the book is its extreme compression, which gives the whole volume the appearance of a reprint of a student's notes on lectures, rather than of the lectures themselves, an independent reader would therefore find the book very tiring, but a student already attending a course of lectures could use it with comfort to supplement his own notes, and to recall in a more authoritative form what he had already been taught by word of mouth The author has, however, been quite lavish in certain directions, notably in supplying 26 full-plate illustrations of distinguished chemists, these are admirably reproduced, and are in marked contrast to the rough line-drawings in the text, and to the printing, which is on paper of such transparency that it is often possible to read words which are printed on the other side of the sheet, with the result that the pages give the impression of being smudged In two other cases the text is fuller than in the majority of similar books, since statistics of production are given, for example, for steel and copper, where the United States are at the head of the list; and, in connexion with the metallurgy of copper, the author has allowed himself two full-page photographs and a full-page diagram, in addition to two pages of text, to illustrate the smelting and refining of the metal

The earlier chapters are, as a rule, provided with a summary, and exercises on the chapters are given throughout, culminating in a series of more than 200 problems at the end of the volume. The diligent student may therefore be expected to have acquired considerable skill by the time that he has completed the course, but the book is designed for "high pressure" work, and "low pressure" readers would probably prefer to choose some less strenuous compilation

(2) Prof Foster has also compiled a Laboratory Manual, the material for which has been secured during nearly twenty years of actual teaching, and revised from year to year in such a way as to anticipate every possible misunderstanding on the part of the student. The book concludes with an ingenious "preliminary exercise" on the separation of the metals into groups, in the course of which 24 test-tubes of solutions, arranged in alphabetical order, are attacked successively by the familiar group-reagents. The work of compilation has been done well, and the work will be helpful to other teachers who are responsible for practical classes in elementary chemistry.

Our Bookshelf.

Quantitative Organic Micro-analysis. By Prof Fritz Pregl. Translated from the second revised and enlarged German edition by Dr Ernest Fyleman. Pp xv+190. (London: J and A Churchill, 1924) 12s 6d. net.

THE quantitative analysis of minute amounts of organic solids and liquids is an art (or should we say handicraft?) which owes more to Prof Pregl than to any other worker, and the award of a Nobel prize to him a few years ago was a fitting tribute to his successful services in this field At present confined almost exclusively to biochemistry (where it will be useful when the elusive vitamin is isolated), organic micro-analysis has an important future before it.

After devoting a chapter to the Kuhlmann balance, a marvellous instrument which weighs to ± 0 001 mgm. at maximum load (20 gm.), the author describes the determination of carbon and hydrogen, nitrogen, the halogens, sulphur, of arsenic, phosphorus, and copper in organic combination, of the carboxyl, methoxyl, ethoxyl, and methyl groups, and adds a chapter on the determination of molecular weight by the boiling-point method The weight of material required for each analysis is about 12-15 mgm

The micro-methods have many points of similarity with the older classical methods of Liebig, Dumas, and Carius, and have obviously been developed from these by dint of tremendous patience and devotion to detail, as well as of unusual practical skill. These newer methods demand a very special technique, the acquisition of which would provide a valuable training to the student after—not before—he has mastered the principles and practice of ordinary analysis. Technique is, as a rule, best learnt in the laboratory from a colleague or instructor, not from a text-book, but in the present case the use of a text-book is fully justified, because organic micro-analysis is still very little known in Great Britain, and also because the directions given by Pregl are so detailed, that it is difficult to conceive how any well-trained chemist could fail to learn from them.

One does not, of course, look for literary skill or grace in a work of this kind, and one does not find them. Like most German technical treatises, the style of this work is heavy, and the translator, of set purpose, has not lightened it. As a literal translation the English version is good, but it would have been much better if the German style had been less rigidly reproduced "Pregl" is an important work, and both publisher and translator deserve our thanks for having made it available to the increasing number of chemists who either cannot read German, or cannot read it with ease or pleasure.

The Heavens By J H Fabre Translated by Dr E E. Fournier d'Albe Pp xvi+336+16 plates (London · T Fisher Unwin, Ltd, 1924) 15s net.

FOR lucidity of style, for simplicity of language, and for felicity in illustration, this book on descriptive astronomy is probably unique. Many passages are quite poetical, as, for example, that (pp 90, 91) on morning, noon, and night, while the charm of others, such as the concluding paragraphs of the lesson on hour and longitude, lies in their wealth of descriptive allusions. Even the elementary mechanics becomes absorbing when clothed in such vivid language, and the explanation of how the earth is weighed, and of such subjects as parallax, inertia, and centrifugal force, are presented in a most attractive style

The work is divided into twenty-five lessons, or chapters, and of these all, except three, are concerned with the solar system, and principally with an elementary presentation of its mechanics There is a preliminary lesson on simple geometry, and by the employment of these "modest geometrical studies" the earth is surveyed, and is weighed, the Cavendish experiment being very clearly explained It is then girdled with circles of latitude, and with meridians of longitude, its rotation is made clear, and the effects of the illumination of the atmosphere and of the refraction of light are applied There is also a very good chapter on the calendar These are specimens of the topics dealt with, and there are also chapters on the sun, the moon, the planets, the comets, the fixed stars, and the nebulæ.

The translation is very well done, and there are several notes by the translator to bring the matter in the text up-to-date But we think that it would have been an advantage had the translator also edited out-of-date statements in the text, as, for example, that Uranus has eight satellites, that the best method of determining solar parallax is by the transit of Venus, as also the distances in light-years given for some of the stars, which are founded on antiquated data The name Herschel is always wrongly spelt There are other obvious slips, probably due to faulty proof-reading A. L. C.

British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report Zoology, vol 8, No. 1: *Crustacea.* Part 8 *Euphausiacea* By Prof W. M. Tattersall Pp 36 + 2 plates (London: British Museum (Natural History), 1924) 5s

THERE are very few groups of invertebrate animals of which it can be said with any probability that nearly all the existing species have now been discovered. This claim was made some years ago by Dr H. J. Hansen as a result of his extensive studies on the Crustacea of the order Euphausiacea It is supported by the fact that, in the report on the very large collections of this group made by the *Terra Nova* expedition, Prof Tattersall has not found it necessary to describe a single new species He discusses the characters and synonymy of a number of the species and describes a series of the larval stages of *Euphausia longirostris*, which is shown to differ from some of its congeners in having a prolonged larval life and in reaching an unusually large size before assuming the adult form. A considerable part of the memoir is devoted to discussing the distribution of the species obtained in the three areas chiefly explored, the Atlantic, the New Zealand region, and the Antarctic and Subantarctic zones south of New Zealand

It is pointed out that nearly all the specimens were taken in the surface waters at night During the daytime very few euphausians were taken, and these were, for the most part, larvæ. While a daily vertical migration to and from the deeper strata of the ocean

has been definitely shown to occur for some species, and is probably characteristic of the epiplanktonic species in general, this explanation does not apply to all cases In coastal waters, euphausians are sometimes observed at the surface in daylight, and their absence from the tow-net catches may be due to their being able to see and avoid the slowly moving tow-nets. The "full speed" nets used on the *Terra Nova* do not seem to have been efficient for the capture of such comparatively large organisms

Les Insectes parasites de l'homme et des animaux domestiques Par E. Séguy. (Encyclopédie pratique du Naturaliste, tome 18.) Pp 442 (Paris. Paul Lechevalier, 1924) 30 francs

FRANCE has produced many notable parasitologists, and Brumpt, Neveu-Lemaire, Blanchard, and Railliet are familiar names of authors of text-books on their subject M Séguy is chiefly known as a dipterist, and his studies on mosquitoes have evidently led him to embrace the wider field of parasitology Although only five orders of insects directly affect man or his domestic animals, a vast literature has grown around them, and the task of treating them at all adequately from the aspect of parasitology is an unusually heavy one The handbook of M. Séguy is notable as a very concise and practical illustrated epitome of the subject. He has succeeded in compressing within its small compass a really large amount of accurate information.

The Diptera, being the largest order the parasitologist has to contend with, naturally comes in for the major share of treatment. In dealing with this group, the author adopts the heterodox classification of Lameere, who divides the order into only Nemocera and Brachycera The latter sub-order is made to include the Nemocera Anomala of Osten Sacken, the Brachycera and all the Cyclorrhapha of the more usual systems. This feature renders the section devoted to Diptera rather difficult to follow until one's previous ideas have been readjusted accordingly. The Mallophaga, Anopleura, and Aphaniptera are also adequately dealt with, but among the Hemiptera the Reduviidæ are perhaps dismissed rather too summarily. The book concludes with a well-chosen bibliography of more than 300 references, which, along with the numerous footnotes, includes most of the important sources of information A. D. I.

The Romance of the Apothecaries' Garden at Chelsea. By Dr F. Dawtrey Drewitt Second edition Pp. 136+15 plates. (London and Sydney · Chapman and Dodd, Ltd, 1924) 5*s* net

How many persons pass daily by the modest botanical garden in Swan Walk, Chelsea, in blissful ignorance of its origin, its antiquity, and the romance attached to it. Dr. Drewitt's charming little work would tell them that it was established about 1673 by the Society of Apothecaries in order that their apprentices might make themselves familiar with the plants used in medicine that, later on, they would be prescribing for their patients It would give them an insight into the separation of the Apothecaries from the Grocers, of the opposition the new Company had to face, the vicissitudes through which it had to pass, and the sacrifices it had to make to maintain its garden. Dr. Drewitt has understood how to weave into his account much of the changes that London and the surrounding villages have undergone during the last three centuries. He tells us of Johnson, Miller, Sir Hans Sloane, Sir Joseph Banks, and other celebrated men who did so much for the Garden, which attained so high a reputation that, as a letter written by a friend of Linnæus to Miller when curator clearly shows, it was the Apothecaries' Garden which brought Linnæus to London. The second edition of the book contains many additional details concerning the history of the trees in the Garden, so that even any one accustomed to use it for the purposes of study will take a far greater and more intelligent interest in it. The book is most fascinating, and can be read again and again with pleasure and profit.

The Kinetic Theory of Gases By Prof Eugène Bloch. Translated by P A Smith. Pp xiv+178 (London Methuen and Co, Ltd, 1924) 7*s* net

THIS translation, which is taken from Prof. Bloch's work, dated 1921, should meet with a welcome from English readers The work contains a large amount of information on subjects which commonly find no place in the average text-book. Recent investigations have made the kinetic theory of fluids one of the most vital branches of theoretical physics. Experimental progress has gone hand in hand with the development of theory. There are interesting chapters on statistical mechanics, the theory of quanta, and the Brownian movement and fluctuations At first sight the width of spectrum lines scarcely seems related to the subject of the book, but the author shows clearly how the width depends on the collisions of the molecules and on their thermal motions. The translator, who has done his work in a very satisfactory manner, has prepared a more complete bibliography of recent papers dealing with the subjects discussed in the various chapters of the book.

Hellenistic Philosophies. By P E More (The Greek Tradition from the Death of Socrates to the Council of Chalcedon, 399 B.C. to A.D 451, Vol 2) Pp. v+385 (Princeton Princeton University Press; London Oxford University Press, 1923.) 13*s* 6*d*. net

THIS is the second volume (the first dealt with the religion of Plato) of a notable comprehensive account of the Greek philosophical tradition In Mr More's view, it ends in scepticism, but arises to new life in Christianity. Two other volumes carrying on the tradition are promised Mr. More writes with ease and distinction and the book is beautifully printed The absence of an index seriously handicaps it as a book of reference.

Practical Organic Chemistry. By Prof Julius B Cohen. Third edition. Pp xv+520 (London: Macmillan and Co, Ltd, 1924) 6*s*. 6*d*

STUDENTS of organic chemistry are indebted to Prof. Cohen for a series of excellent text-books, and this revised edition of his "Practical Organic Chemistry" reaches a high standard It covers a wide field, including biochemical preparations, and references to the literature are given. A good feature is the very instructive collection of explanatory notes The book may be recommended as by far the best in any language, and the price is most reasonable.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Origin of Sponge-Spicules.

To account for the extraordinarily beautiful and varied forms of sponge-spicules, with their wonderful symmetry, has long been one of the most puzzling problems of the zoologist After more years of investigation than I care to number, I have arrived at certain conclusions that may interest the readers of NATURE It is, however, a long story, of which I cannot here give more than the barest outline, to be followed, I hope, by a fuller account in another place For the sake of brevity I must also confine my remarks almost exclusively to siliceous spicules

The generally accepted idea that these spicules arise in "mother-cells" must be abandoned, the so-called mother-cells being, in fact, cells which have enveloped the growing spicule secondarily, after the fashion of phagocytes Their function is either, as silicoblasts, to deposit silica upon the spicules, or, as simple amœbocytes, to carry them from place to place. The primary axis around which the silica is deposited is the protorhabd (axial thread), represented in old and eroded spicules by the axial canal The origin of the protorhabd has hitherto been a complete mystery I believe that it begins as a very minute granule, resembling a micrococcus, capable of movement from place to place, of multiplication by fission, and of growth by elongation and sometimes branching Regarded as quasi-independent organisms, living symbiotically with the sponge, these granules may be termed sclerococci, looked on simply as spicule initiators, they may be termed scleroplastids Around the usually much elongated scleroplastids, or protorhabds, concentric layers of silica are deposited by silicoblasts, which associate themselves temporarily with the spicules for this purpose, and may exercise a mechanical influence upon their form

The number and arrangement of the rays of the spicule depend upon the number of divisions of the original scleroplastid and the positions which the products of these divisions take up In the tetract spicule, for example, the original scleroplastid divides into four, which arrange themselves in the form of a pyramid and then elongate centrifugally Secondary growing points may be established by other scleroplastids settling down upon the young spicule and forming new centres of silica deposition

The evidence on which these conclusions are based can only be summarised in the briefest manner

(1) In *Stelletta hæckeli* we find many abnormal tetracts (triænes) with more or less suppressed rays, forming a well-graduated reduction series, the protorhabds (still indicated by the axial threads), having been checked in their growth and completely enveloped in silica at various stages of elongation (Fig 1, 1-5) This reduction series culminates in a perfect sphere of concentrically laminated silica (Fig 1, 6), with a minute granule, representing the original scleroplastid, in the centre Such spheres are not infrequently met with in siliceous sponges and have been called "siliceous pearls"

(2) Abnormal spicules are often found with adventitious rays developed in unusual situations, and sometimes distinguishable as shafts and cladi These are to be explained on the hypothesis that wandering scleroplastids settle haphazard on the young spicule and there initiate each its own special kind of ray In Schmidt's *Stelletta pathologica* nearly all the larger spicules are quite abnormal, formed of rays that have come together apparently by chance, like the members of an Empedoclean monster

(3) The amphitriæne, which occurs rarely, and usually, if not always, as an abnormality, is readily explicable as a case of incomplete twinning due to abnormal but symmetrical divisions of the original scleroplastid

(4) I suggested some years ago that in certain spicules with whorled outgrowths the whorls are initiated by groups of "formative" or "initial cells," which settle on the nodes of a vibrating rod, a conclusion which was mathematically supported in a very striking manner by Prof J W Nicholson These so-called initial cells are really very minute growing points, in each of which a scleroplastid probably forms a centre of attraction for the silica In the anisodiscorhabds of *Latrunculia bocagei* there are normally two tripartite whorls, each with three growing points. Cases of complete twinning sometimes occur, in which two such spicules, of greatly reduced size, develop

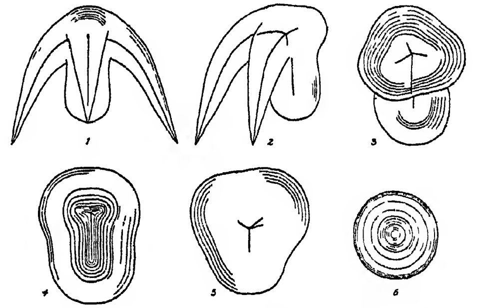

FIG 1 —Suppressed tetract spicules (triænes) of *Stelletta hæckeli* × 140.

side by side, but each of these twins has only one whorl This indicates very clearly that the scleroplastids initiating the two whorls have undergone the usual number of divisions but that their products have distributed themselves over two spicules instead of one

This last observation seems to me conclusive as to the existence of the scleroplastids as mobile and dividing granules of extremely minute size The evidence that these are symbiotic organisms (sclerococci) is admittedly less convincing, but seems to me fairly strong

(1) It is well known that along various lines of phylogenetic descent entire spicule categories mysteriously drop out Thus we have Stellettids that have lost their triænes, Desmacidonids that have lost their chelæ, and so on In Chondrilla all the megascleres have disappeared, and in Chondrosia there are no spicules left at all I was formerly inclined to attribute this loss to the dropping out of Mendelian factors It may be more simply explained as being due to non-infection by sclerococci.

(2) Various cases of the abnormal occurrence of particular types of spicule may be explained by abnormal infection.

(3) In the Euceratosa, with the exception of Darwinella, there are never any spicules at all Darwinella, however, has, in addition to the normal horny skeleton, radiate spicules composed of spongin, presumably deposited around protorhabds

(4) In many species of Mycale and Esperiopsis three types of chelæ occur This may be interpreted to mean that the sclerococci sometimes conjugate and occasionally hybridise, so that we get the two parent

forms of chela and a hybrid. But more evidence is required before this view can be definitely established.

It is difficult to regard the scleroplastids (sclerococci) as genuine constituents of the sponge. They are not nucleated cells but seem to resemble Bacteria in many respects, and I suggest that they are handed on from generation to generation of sponges by egg-infection. The sponge converts many of these symbionts into spicules (siliceous, calcareous, or horny as the case may be), and then makes use of the larger ones by building them up into a more or less regular skeleton. The smaller ones it usually makes no use of at all, but either removes them by means of phagocytes or leaves them scattered irregularly through the soft tissues. It may be suggested that it is a case of parasitism rather than symbiosis, but evidently the sclerococci are not all destroyed by the sponge, and both parties probably benefit by the association.

Experimental investigations by means of inoculation and so forth remain to be attempted, and I hope that this communication may serve to direct attention to a new and promising field of research. The fact that naked sclerococci have not yet been recognised may very well be due to the difficulty of distinguishing them from ordinary Bacteria and from other minute granules with which the tissues of sponges abound.

ARTHUR DENDY.

King's College, London,
January.

On the Excitation of Spark Spectra.

THE great number of unsuccessful attempts to observe a spark spectrum of lithium have proved the difficulty of exciting, by means of the ordinary methods, the spark spectrum of an element when the excitation potential is high compared with that of the arc spectrum of the same element. Owing to the great interest which is attached not only to the lithium spark spectrum, but also to many other spark spectra which have hitherto not been observed, experiments have been carried on at this Institute during the last two years with the purpose of developing a method which should make it possible to produce spark spectra having a high value of the excitation potential. An apparatus was designed, in which the vapour of the element under investigation was allowed to escape into a high vacuum from a little hole in a crucible, heated by an electric furnace, and where this vapour could be exposed to a bombardment by a strong current of electrons. By evacuating the apparatus to a pressure below 0.001 mm., and by means of a special design of the orifice of the crucible, it was possible to produce and accelerate these electrons, before they could collide with the atoms of the escaping vapour. In the latest construction of the apparatus, the distance from the tungsten filament to the grid was 1-2 mm., the distance from grid to the crucible 10-15 mm., and the electron current was, by means of an anode behind the crucible and a ring near the grid, concentrated on the hole of the crucible where the concentration of vapour was a maximum. The electron current was usually of the order of 200-300 ma, but could without difficulty reach more than 500 ma. Accelerating voltages up to 1400 volts have been applied.

In the first experiments the crucible was filled with easily evaporated metals like sodium, potassium, cadmium, and zinc, and promising results were obtained. Besides the arc spectrum, which was always fully developed with high members of the series, the spark spectra of these elements were observed with considerable intensity at low accelerating potentials of a few hundred volts. Also, with salts in the crucible, spark spectra were in various cases obtained without difficulty.

Owing to the very high boiling-point of metallic lithium and the small dissociation of its salts, it was not found possible in the first apparatus, where the crucible could not be heated above 600°, with this element to produce a sufficient high vapour pressure. With a redesigned apparatus, in which the crucible could be heated to 1000° C., we succeeded, however, in obtaining several lines of the lithium spark spectrum which appeared with considerable intensity with an accelerating voltage of about 300 volts.

While this second apparatus was under construction, Schuler in a recent note (*Die Naturwissenschaften*, July 11, 1924) communicated various important results regarding the lithium spark spectrum, obtained by the beautiful method of the hollow cathode, developed by Paschen. In addition to the line 2934 Å.U., ascribed to lithium by Mohler (*Phys. Rev.*, 23, 108, 1924), Schuler observed a number of new lines which made possible the establishment of the main features of a series scheme with fourfold Rydberg constant, which therefore was ascribed to the singly ionised lithium atom. In accordance with the theoretical expectation, that this spectrum should show a great similarity with the ordinary helium spectrum, it was also found possible in the spectrum to recognise two separate series systems. At the same time, observations of a number of lines ascribed to the lithium spark spectrum were recorded by M. Morand (*C.R.*, May 1924). The method of excitation used in his work was that of anode rays. While in our experiments only few of the lines given by Morand could be verified, most of Schuler's results were confirmed, although it seemed necessary to introduce small corrections in some of his wave-lengths, and a few modifications in the series scheme proposed. The results are stated in the following table, where the wave-lengths are given with an average accuracy of about 0.4 Å.U. The numbers in brackets are the estimated intensities.

TABLE I.

5485.5	(6)	$2s$-$2p$	3200.4	($\frac{1}{2}$)	$3D$-$5F$
4881.5	($1\frac{1}{2}$)	$3p$-$4s$	3196.5	(1)	$3d$-$5f$
4678.1	(1)	$3D$-$4F$	3155.4	(1)	$3p$-$5s$
4672.0	(3)	$3d$-$4f$	3034	($\frac{1}{2}$)	$3P$-$5D$?
4347	($\frac{1}{2}$)	$3P$-$4D$?	3029.7	($\frac{1}{2}$)	$3p$-$5d$
4325.7	(2)	$3p$-$4d$	2934.2	(3)	$2S$-$2P$?
3685.0	(1)	$3s$-$4p$	2729.9	($\frac{1}{2}$)	$3D$-$6F$
3285.8	(1)	$3S$-$4P$?	2728.9	(1)	$3d$-$6f$
			2612	($\frac{1}{2}$)	$3P$-$6D$?

Following Schuler, a term notation analogous to that of the helium spectrum is used, the terms denoted by small letters being assumed to correspond with the helium terms of the doublet series, while the terms denoted by capital letters are assumed to correspond with the helium singlet system. While most of the lines were rather faint compared with the arc-lines, the line 5485.5 was comparatively bright, and appeared, when observed visually, with about the same intensity as the red and yellow lines of the lithium arc spectrum. This line was originally ascribed by Schuler to the presumed singlet spectrum, but from a more recent observation, kindly communicated to this Institute by Prof. Paschen, that the line in question when observed with high dispersion exhibits a complex structure, Schuler has later concluded that it must belong to the doublet spectrum. This conclusion is also in conformity with our measurements. Not only does it seem impossible in any other way to account for its intensity relative to the other observed lines, but also the absolute value of the wave-length is in complete agreement

with what should be expected from the series relation given in Table I In fact, this leads to the following scheme of the terms of the doublet spectrum.

TABLE II.

$2s = 134{,}056$ ($n^* = 1{\cdot}81$)	$2p = 115{,}831$ ($n^* = 1\ 95$)	$3d = 48{,}828$ ($n^* = 3\ 00$)	$4f = 27{,}430$ ($n^* = 4\ 00$)
$3s = 55{,}308$ ($n^* = 2\ 82$)	$3p = 50{,}566$ ($n^* = 2{\cdot}95$)	$4d = 27{,}455$ ($n^* = 4\ 00$)	$5f = 17{,}552$ ($n^* = 5\ 00$)
$4s = 30{,}086$ ($n^* = 3\ 82$)	$4p = 28{,}180$ ($n^* = 3\ 95$)	$5d = 17{,}569$ ($n^* = 5\ 00$)	$6f = 12{,}193$ ($n^* = 6\ 00$)
$5s = 18{,}883$ ($n^* = 4\ 82$)	.	...	.

The numbers in the brackets are the effective quantum numbers of the various terms It will be seen that these numbers exhibit a great similarity with those of the helium-doublet spectrum, although the differences from the corresponding hydrogen values are slightly smaller in the case of the lithium spark spectrum, as should also be expected from general theoretical considerations On account of the smaller number of the observed singlet terms and the great uncertainty attached to their series arrangement, we have confined ourselves to giving in Table I a preliminary series notation

In addition to the spark spectrum of lithium, the arc spectrum (lithium I-spectrum) was very strongly excited The sharp and the diffuse series were observed up to the 10th and the 14th member, respectively

No attempt was made to determine the minimum excitation potentials of the spark spectrum lines, but it was observed that between 150 and 200 volts accelerating potential, the intensity of the line 5485 Å U. decreased very rapidly relative to the arc lines An increase of accelerating potential from 300 volts to 1000 volts had no effect on the relative intensity of the arc and spark spectrum

In addition to this method of excitation by means of impacting electrons, the lithium spark lines were also obtained under somewhat different conditions. If the vapour pressure was high and the potential between the crucible and the anode was more than 500 volts, then under the electron bombardment an arc would strike between the crucible and anode, and this arc would continue even after the electron current was cut off This arc, in which the potential drop was 400-500 volts, and the current 400-500 ma, showed a brilliant luminescence and exhibited besides the ordinary arc lines also the spark lines, especially the line 5485 Å.U., with considerable intensity However, excited in this way, the relative intensity of the spark spectrum compared with the arc spectrum is much smaller than when the spectra were excited by means of electron bombardment The work will be continued

The writer wishes to express his thanks to Dr. J A Christiansen, in collaboration with whom the first apparatus was designed, but who was prevented from taking part in the further developing of the work.

SVEN WERNER
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Copenhagen, January 6

Rainfall Correlations in Trinidad.

AN important feature of modern economic geography is the study of the relationship between climatic conditions and industry Regarding climate and weather as being respectively the static and dynamic aspects of meteorological conditions, we have in the tropics, as Dr Martin Leake has recently emphasised, climate a determinate factor in the location of industries and colonies of people, weather, on the other hand, is frequently the most important factor underlying local industrial *variation*. In the tropics, rainfall is generally the chief weather factor affecting crop yields, and in Trinidad (West Indies) the writer has given some attention to the relationship between variation in rainfall and yield of cacao—the island's principal product This work has definitely established the fact that the annual variations in yield, which may deviate as much as −101 8 per cent. of a 5-year moving average (River Estate, 1921–22), are fundamentally due to variations in rainfall, though the exact extent of the connexion has not been statistically determined in all cases

The procedure followed in the investigation was to obtain monthly rainfall and monthly crop-yield records for as many years back as possible (generally not more than 15) from the most reliable individual estates, and to work on the data for each estate separately Finally, the annual output of cacao for the whole island was considered in relation to the average annual rainfall for all cacao districts On the whole, I am satisfied that the data obtained are sufficiently trustworthy for the purpose of affording general indications

It will be well to emphasise, however, that studies like the present one cannot be regarded as purely statistical. we are dealing, not with the rainfall itself but with its ultimate effects, and it is necessary to have at least an elementary knowledge of the physiological nature and habits of the cacao tree (in this particular study) in order to anticipate lags and to deal intelligently in general with the data There is also the question of increasing or declining output as affected by agricultural management The latter difficulty is partly overcome by plotting the yield deviations from moving averages for, say, 5-year periods. In general the "dot chart" method of plotting yield against rainfall to indicate linear correlation was employed, and in cases where the points clustered adequately, the coefficient of correlation was computed. In all cases the percentage deviations from the averages were plotted as well, in order to compare the magnitude of the variations on the same scale It is not possible in this short note to reproduce the graphs and all the computations, but they are available for reference The following table gives the general conclusions arrived at.

Estate	Geographical location	Av ann. rainfall in. (approx)	Correlation · Yield and rain of "wet" months	Correlation Yield and Nov rain
La Vega	Central Range	84	Negative	None
Non Pareil	East end of N Range	95	Negative	Positive
Verdant Vale	Central N Range	85	Negative	Positive
River .	West end of N Range	67	(Inconclusive)	(Inconclusive)
All cacao Districts	North, Central and S E	73 (weighted)	Positive within limits	(Undetermined)

It would appear that estates with an average annual rainfall of 80 inches and more are less adapted for cacao, other things being equal, than estates with an average annual rainfall lying between 70 and 75 inches In the case of La Vega estate the negative correlation was found to be extremely definite, the highest and most remarkable coefficient being in respect of the May and June rainfall and the subsequent crop This was found to be $-0\ 95 \pm 0\ 10$ It is necessary to mention that this computation was made under my direction but that I have not verified it. For the rainfalls of May only, however, and subsequent yields, I myself obtained a coefficient of $-0\ 85 \pm 0\ 15$, which is equally, if not more surprising, because it refers to one month of the year only, and that six months prior to the coming in of the crop affected.

Verdant Vale estate has a coefficient for November rain of 0 65±0 05 The apparent importance of adequate rain during November in the Northern Range of hills is interesting, and this and many other points require further study

Generally speaking, rainfall seems to be a fundamental factor underlying the whole economic activity of Trinidad A close connexion was found by the writer between rainfall in Port of Spain and the electric tram-car takings, and between the business done in the shops The latter is partly due to synchronic weather changes, and partly the effect of the previous year's rainfall and crop yields affecting the purchasing power of the inhabitants

On the principal rubber estate I found the well-known connexion between daily rainfall and the quantity of rubber tapped from the trees The connexion here is due to purely physical reasons, rain causing the latex to flow over the bark instead of down the central channel into the cup The influence of rainfall on sugar-cane and coconut yields was not studied, but it may be of interest to mention that considerable work on the former relationship has been done in other countries The most important, perhaps, of this work is A Walter's analysis of climatic factors and the cane crop in Mauritius, that of M Kœnig in the same Colony, and the work of T. A Tengwall and C E. van de Zyl in Java, which has recently established a positive correlation between sugar yield per bouw and amount of rain in October and November A very good summary of the results obtained in the United States in regard to weather factors and cotton, Indian corn (maize) and tobacco, is to be found in J W Smith's "Agricultural Meteorology" Most of the correlations obtained in connexion with rainfall and tropical and sub-tropical crops have been in the neighbourhood of 0 60 with probable errors indicating a fair degree of significance

In conclusion, I should like to emphasise the importance of this work not only from the point of view of physiology and agriculture, but also from the wider point of view of economic geography Conditions in tropical countries have, for the most part, been fully described, what is needed now is statistical analysis and co-ordination, and from a broad administrative point of view. In Trinidad the general complaint is that short cacao crops are due to drought On many of the best and largest estates my work indicates that the trouble is the result—or partly the result—of too much rain W. R DUNLOP

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Astrophysics without Mathematics.

SIR JOSEPH HOOKER in 1869, in undertaking to review a book for a journal of science, made the following remark "I hope that . will give us better analyses of books than reviews in general afford us We have no end of reviews, but they are generally the author's views on the subject of the book to be reviewed and convey no precise information as to the books themselves This is a crying evil" The review by "E A M" in NATURE of January 10 of my book, "Modern Astrophysics," is a particularly good specimen of the type of review to which Hooker very properly took exception The reader of this review who has not seen the book will have not the remotest idea of what I have tried to do, or of the intended (E A M calls the book "amorphous") structure of the book as revealed, say, by the titles of its sections and chapters Instead of this relevant and, one would have thought, indispensable matter, he is treated to a catalogue of E A M's misapprehensions of the subject and of his differences from me in matters of opinion.

The book is condemned from the literary point of view, it is implied that it is difficult to comprehend, and a large number of "omissions" and "errors" are selected as examples of "looseness" of reasoning. With regard to the first two points, E A M's remarks, when examined, condemn themselves, and need no comment He is entitled to his opinion, which he is unfortunate enough not to share with a single one of the critics whose qualifications to review the book are of a literary character I wish only to remark that E A M has either not read or forgotten the preface to the book, and that his statement that the reader "is conducted twice round the whole existing observational material" is untrue.

The main part of the "review" is occupied with criticisms of points of detail E A M has evidently been peering into the book in order to make a collection of all the trivial points to which he can object, and as a result he puts forward eleven points of this kind The reader of the "review" will probably be surprised to learn that the whole of the material in the book dealing with all except one of the points criticised by E A M, when put together, would make up almost exactly one page The material dealing with the remaining point occupies four and a half pages The book contains about 475 pages

It is clearly an abuse of a reviewer's authority to concentrate on points of this kind, even if his criticisms on those points are valid E A M, however, has not even that excuse The only criticism in which I admit he is justified is that I have omitted to describe the general method of determining cluster parallaxes For pointing out that omission I am indebted to him. On the other matters I have written to him personally, pointing out where he has blundered. If, after reading my letter, he so wishes, I am quite prepared to discuss any or all of the points with him when, where, and in whatever reasonable manner he may choose, in public or in private Considering the tone in which his "review" is written, it is incumbent upon him to accept this offer or to withdraw his remarks at once

It is very unpleasant to have to reply to a review, but the misrepresentation and tone of E A M's essay leave me no alternative in the interests of the truth I have tried to present in my book

HERBERT DINGLE

Imperial College of Science and Technology,
January 15, 1925

I AM sorry that my review has caused Prof Dingle so much pain, and I must beg him to accept my assurance that purely scientific considerations were in my mind My review contains evidence that there were portions of the book which I read with pleasure, and I take this occasion to say so explicitly. I cannot see that my criticisms were outside the province of a reviewer, but I deeply regret that they should have been expressed in language which Prof. Dingle finds discourteous

With regard to the substance of my criticisms in the main part of the review, I should not have made them unless I were fully prepared to justify them After carefully examining the arguments brought forward by Prof Dingle in his personal letter to me, I am unable to withdraw any of the ten points to which he objects, but I am willingly availing myself of the opportunity of discussing them with him privately I am unable to agree with Prof Dingle that the points raised are trivial They all seemed to me either to be of fundamental importance in themselves or to involve fundamental principles.

E A. MILNE

Trinity College, Cambridge.

The Structure of the so-called Ultraviolet Bands of Water Vapour.

THE so-called ultraviolet bands of water vapour, which must probably be attributed to the OH-molecule,[1] have been the object of an extensive study Heurlinger[2] succeeded in arranging almost all the lines of the band λ 3064 into 12 branches which he called P_1^k, Q_1^k, R_1^k, P_2^k, Q_2^k, R_2^k ($k=1, 2$) But it was not possible to give a theoretical interpretation of the bands, and to decide to which quantum states of the molecule the lines belong[3] Recently, Watson[1] measured the band λ 2811 and showed that it has exactly the same structure as the band λ 3064 These measurements, combined with those of Grebe and Holtz of the band λ 3064, enable us to get a complete insight into the structure of these bands With the aid of the combination principle it is possible to get the relative values of the rotational terms without any theoretical assumption about the structure of the molecule The results obtained are summarised below (Details will be published in the Proc Roy Acad Amsterdam)

(1) The six branches P_i^1, Q_i^1, R_i^1 ($i=1, 2$) form one band which we shall denote by I, and the branches P_i^2, Q_i^2, R_i^2 another band (II), so that what is called a band consists in reality of two bands, which must be attributed to different oscillation transitions, *e g*

	I	II
λ 3064	$0 \rightarrow 0$	$1 \rightarrow 1$
λ 2811	$1 \rightarrow 0$	$2 \rightarrow 1$

(the transition $0 \rightarrow 0$ for λ 3064 I is chosen arbitrarily). Then λ 2811 I and λ 3064 II must have the same initial state, which is confirmed by the combination principle That the bands λ 3064 and λ 2811 have the same final state was already pointed out by Watson

(2) The six branches of one band must be represented by the following scheme

$$\begin{array}{ll} P_1(m)=F_1(m-1)-f_1(m) & P_2(m)=F_2(m-1)-f_2(m) \\ Q_1(m)=F_1(m)-f_1'(m) & Q_2(m)=F_2(m)-f_2'(m) \\ R_1(m)=F_1(m+1)-f_1(m) & R_2(m)=F_2(m+1)-f_2(m), \end{array}$$

which is derived from the relations—

$$\left.\begin{array}{l} Q_i(m)-P_i(m+1) \\ R_i(m)-Q_i(m+1) \end{array}\right\} \text{are the same for } \lambda\ 3064 \text{ and } \lambda\ 2811$$

$$R_i(m)-P_i(m) \quad \text{are the same for } \lambda\ 3064\ \text{II and } \lambda\ 2811\ \text{I}$$

$$Q_i(m)-P_i(m+1) \neq R_i(m)-Q_i(m+1) \text{ in one band}$$

(3) As is well known, the lines do not follow Deslandres's rule for small values of m There must therefore be a component of the electronic impulse along the axis of figure as well as one perpendicular to it[4] The terms cannot be represented by the formula of Kramers and Pauli, or by the modification of it with which Kratzer[5] succeeded in representing the terms of the (C+H) bands This shows that the electronic impulse cannot be connected quasi-rigidly with the molecule It seems that the electronic impulse has a precession which increases with growing m

(4) Fortrat[6] showed that most of the lines are accompanied by satellites It is very probable that these satellites arise from the same quantum states of the molecule as the lines themselves, which indicates that they are also combinations between the terms given above The three satellites of Q_2 are then, for example,

$$F_1(m)-f_2'(m) \qquad F_1(m)-f_2(m) \qquad F_2(m)-f_2(m)$$

The precision of the measurements, however, does not permit of deciding this question with certainty It is not impossible that there are other terms slightly different from the former ones which are responsible for the satellites

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[1] W W Watson, *Astroph Journal*, 60, p 145 (1924)
[2] T Heurlinger, "Untersuchungen über die Struktur der Bandenspektra," Lund, 1918
[3] Cf A. Sommerfeld, "Atombau und Spektrallinien," 3rd ed p 527
[4] H A Kramers and W Pauli, *Zeit f Phys*, 13, p 351 (1923)
[5] A Kratzer, *Zeit f Phys*, 23, p 298 (1924)
[6] R Fortrat, *Journal de Phys*, 5, p. 20 (1924)

Hafnium Oxide in Tungsten Filaments.

IT has been known for a long time that perfectly pure tungsten cannot be used for the manufacture of filaments for electric lamps on account of its "off-setting" structure due to recrystallisation It has been found also that recrystallisation can be essentially influenced by suitable additions Thus, for example, thorium oxide or silicon oxide can be used with good results

By mixing tungsten oxide with a solution of hafnium nitrate, evaporating the latter to dryness, heating the product obtained and reducing it then with hydrogen, tungsten powder is formed, having a definite content of hafnium oxide In my experiments the latter was comprised between 0·1 and 3 per cent

During the subsequent sintering operation in hydrogen to which the compressed and heated rod is submitted, a small part of the hafnium oxide is reduced, and the hafnium produced combines with the tungsten During the subsequent swaging operation, this formation of a solid solution causes difficulties which can be easily obviated by using nitrogen or rare gases instead of hydrogen In this case the swaging and drawing operation is readily effected

The hafnium oxide is distinguished by its high melting-point and its low vapour pressure at high temperatures, so that it has proved to be a suitable addition to tungsten for filaments The vapour tension at the temperature of the sintering operation is so low that no evaporation whatever of hafnium oxide could be ascertained

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Citrus Fruit and Scurvy.

IN "Purchas his Pilgrimage or Relations of the World and the Religions observed in al Ages and Places discovered" there are some interesting references to the disease scurvy The edition I possess is the third, dated 1617, our Public Library in Melbourne having only the fourth, dated 1626

On page 865 of this third edition the following statement occurs "The Scorbute so weakened their men, that they were not able to hoise (*sic*) out their boats, except in the Generalls ship, whose men (drinking euery morning three spoonefuls of the iuice of Limons) were healthfull"

Again, on page 1086 there is a description of scurvy with a marginal printed note as follows "Oranges, Limons, and the like are excellent remedies to this disease."

I regret I have not access to the first and second editions of the work, but as it is, this surely constitutes one of the earliest references to the citrus cure or prevention of scurvy

W A OSBORNE
The University of Melbourne,
December 9

Australopithecus africanus: The Man-Ape of South Africa.

By Prof. RAYMOND A DART, University of the Witwatersrand, Johannesburg, South Africa.

TOWARDS the close of 1924, Miss Josephine Salmons, student demonstrator of anatomy in the University of the Witwatersrand, brought to me the fossilised skull of a cercopithecid monkey which, through her instrumentality, was very generously loaned to the Department for description by its owner, Mr E G Izod, of the Rand Mines Limited. I learned that this valuable fossil had been blasted out of the limestone cliff formation—at a vertical depth of 50 feet and a horizontal depth of 200 feet—at Taungs, which lies 80 miles north of Kimberley on the main line to Rhodesia, in Bechuanaland, by operatives of the Northern Lime Company Important stratigraphical evidence has been forthcoming recently from this district concerning the succession of stone ages in South Africa (Neville Jones, Jour Roy Anthrop Inst, 1920), and the feeling was entertained that this lime deposit, like that of Broken Hill in Rhodesia, might contain fossil remains of primitive man

I immediately consulted Dr R B Young, professor of geology in the University of the Witwatersrand, about the discovery, and he, by a fortunate coincidence, was called down to Taungs almost synchronously to investigate geologically the lime deposits of an adjacent farm During his visit to Taungs, Prof. Young was enabled, through the courtesy of Mr A F Campbell, general manager of the Northern Lime Company, to inspect the site of the discovery and to select further samples of fossil material for me from the same formation These included a natural cercopithecid endocranial cast, a second and larger cast, and some rock fragments disclosing portions of bone Finally, Dr Gordon D. Laing, senior lecturer in anatomy, obtained news, through his friend Mr Ridley Hendry, of another primate skull from the same cliff This cercopithecid skull, the possession of Mr De Wet, of the Langlaagte Deep Mine, has also been liberally entrusted by him to the Department for scientific investigation

FIG 1 —Norma facialis of *Australopithecus africanus* aligned on the Frankfort horizontal

The cercopithecid remains placed at our disposal certainly represent more than one species of catarrhine ape The discovery of Cercopithecidæ in this area is not novel, for I have been informed that Mr. S. Haughton has in the press a paper discussing at least one species of baboon from this same spot (Royal Society of South Africa) It is of importance that, outside of the famous Fayum area, primate deposits have been found on the African mainland at Oldaway (Hans Reck, *Sitzungsbericht der Gesellsch Naturforsch Freunde*, 1914), on the shores of Victoria Nyanza (C. W Andrews, *Ann. Mag. Nat. Hist.*, 1916), and in Bechuanaland, for these discoveries lend promise to the expectation that a tolerably complete story of higher primate evolution in Africa will yet be wrested from our rocks

In manipulating the pieces of rock brought back by Prof Young, I found that the larger natural endocranial cast articulated exactly by its fractured frontal extremity with another piece of rock in which the broken lower and posterior margin of the left side of a mandible was visible After cleaning the rock mass, the outline of the hinder and lower part of the facial skeleton came into view Careful development of the solid limestone in which it was embedded finally revealed the almost entire face depicted in the accompanying photographs

It was apparent when the larger endocranial cast was first observed that it was specially important, for its size and sulcal pattern revealed sufficient similarity with those of the chimpanzee and gorilla to demonstrate that one was handling in this instance an anthropoid and not a cercopithecid ape Fossil anthropoids have not hitherto been recorded south of the Fayum in Egypt, and living anthropoids have not been discovered in recent times south of Lake Kivu region in Belgian Congo, nearly 2000 miles to the north, as the crow flies

All fossil anthropoids found hitherto have been known only from mandibular or maxillary fragments, so far as crania are concerned, and so the general appearance of the types they represented has been unknown; consequently, a condition of affairs where virtually the whole face and lower jaw, replete with teeth, together with the major portion of the brain pattern, have been preserved, constitutes a specimen of unusual value in fossil anthropoid discovery. Here, as in *Homo rhodesiensis*, Southern Africa has provided documents of higher primate evolution that are amongst the most complete extant

Apart from this evidential completeness, the specimen is of importance because it exhibits an extinct race of apes *intermediate between living anthropoids and man*

In the first place, the whole cranium displays *humanoid* rather than anthropoid lineaments It is markedly dolichocephalic and leptoprosopic, and manifests in a striking degree the *harmonious relation* of calvaria to face emphasised by Pruner-Bey As Topinard says, "A cranium elongated from before backwards, and at the same time elevated, is already in harmony by itself, but if the face, on the other hand, is elongated from above downwards, and narrows, the harmony is complete" I have assessed roughly the difference in the relationship of the glabella-gnathion facial length to the glabella-inion calvarial length in recent African anthropoids of an age comparable with that of this specimen (depicted in Duckworth's "Anthropology and Morphology," second edition, vol 1), and find that, if the glabella-inion length be regarded in all three as 100, then the glabella-gnathion length in the young chimpanzee is approximately 88, in the young gorilla 80, and in this fossil 70, which proportion suitably demonstrates the enhanced

relationship of cerebral length to facial length in the fossil (Fig 2)

The glabella is tolerably pronounced, but any traces of the salient supra-orbital ridges, which are present even in immature living anthropoids, are here entirely absent Thus the relatively increased glabella-inion measurement is due to brain and not to bone Allowing 4 mm for the bone thickness in the inion region, that measurement in the fossil is 127 mm.; *i e* 4 mm less than the same measurement in an adult chimpanzee in the Anatomy Museum at the University of the Witwatersrand. The orbits are not in any sense detached from the forehead, which rises steadily from their margins in a fashion amazingly human. The inter-orbital width is very small (13 mm) and the ethmoids are not blown out laterally as in modern African anthropoids This lack of ethmoidal expansion causes the lacrimal fossæ to face posteriorly and to lie relatively far back in the orbits, as in man The orbits, instead of being subquadrate as in anthropoids, are almost circular, furnishing an orbital index of 100, which is well within the range of human variation (Topinard, "Anthropology"). The malars, zygomatic arches, maxillæ, and mandible all betray a delicate and humanoid character The facial prognathism is relatively slight, the gnathic index of Flower giving a value of 109, which is scarcely greater than that of certain Bushmen (Strandloopers) examined by Shrubsall The nasal bones are not prolonged below the level of the lower orbital margins, as in anthropoids, but end above these, as in man, and are incompletely fused together in their lower half Their maximum length (17 mm) is not so great as that of the nasals in *Eoanthropus dawsoni*. They are depressed in the median line, as in the chimpanzee, in their lower half, but it seems probable that this depression has occurred post-mortem, for the upper half of each bone is arched forwards (Fig 1). The nasal aperture is small and is just wider than it is high (17 mm. × 16 mm.) There is no nasal spine, the floor of the nasal cavity being continuous with the anterior aspect of the alveolar portions of the maxillæ, after the fashion of the chimpanzee and of certain New Caledonians and negroes (Topinard, *loc. cit.*).

In the second place, the dentition is *humanoid* rather than anthropoid The specimen is juvenile, for the

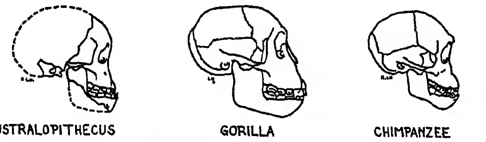

FIG. 2 —Cranial form in living anthropoids of similar age (after Duckworth) and in the new fossil For this comparison, the fossil is regarded as having the same calvarial length as the gorilla

first permanent molar tooth only has erupted in both jaws on both sides of the face, *i.e* it corresponds anatomically with a human child of six years of age. Observations upon the milk dentition of living primates are few, and only one molar tooth of the deciduous dentition in one fossil anthropoid is known (Gregory, "The Origin and Evolution of the Human Dentition," 1920). Hence the data for the necessary comparisons are meagre, but certain striking features of the milk dentition of this creature may be mentioned The tips of the canine teeth transgress very slightly (0 5-0·75 mm) the general margin of the teeth in each jaw, *i e* very little more than does the human milk canine. There is no diastema whatever between the premolars and canines on either side of the lower jaw, such as is present in the deciduous dentition of living anthropoids, but the canines in this jaw come, as in the human jaw, into alignment with the incisors (Gregory, *loc cit*) There is a diastema (2 mm on the right side, and 3 mm on the left side) between the canines and lateral incisors of the upper jaw, but seeing, first, that the incisors are narrow, and, secondly, that diastemata (1 mm-1 5 mm) occur between the central incisors of the upper jaw and between the medial and lateral incisors of both sides in the lower jaw, and, thirdly, that some separation of the milk teeth takes place even in mankind (Tomes, "Dental Anatomy," seventh edition) during the establishment of the permanent dentition, it is evident that the diastemata which occur in the upper jaw are small. The lower canines, nevertheless, show wearing facets both for the upper canines and for the upper lateral incisors

FIG 3 —Norma lateralis of *Australopithecus africanus* aligned on the Frankfort horizontal

The incisors as a group are irregular in size, tend to overlap one another, and are almost vertical, as in man, they are not symmetrical and well spaced, and do not project forwards markedly, as in anthropoids. The upper lateral incisors do project forwards to some extent and perhaps also do the upper central incisors very slightly, but the lateral lower incisors betray no evidence of forward projection, and the central lower incisors are not even vertical as in most races of mankind, but are directed slightly backwards, as *sometimes* occurs in man Owing to these remarkably human characters displayed by the deciduous dentition, when contour tracings of the upper jaw are made, it is found that the jaw and the teeth, as a whole, take up a parabolic arrangement comparable only with that presented by mankind amongst the higher primates These facts, together with the more minute anatomy of the teeth, will be illustrated and discussed in the memoir which is in the process of elaboration concerning the fossil remains.

In the third place, the mandible itself is *humanoid* rather than anthropoid Its ramus is, on the whole, short and slender as compared with that of anthropoids, but the bone itself is more massive than that of a human being of the same age. Its symphyseal region is virtually complete and reveals anteriorly a more vertical outline than is found in anthropoids or even in the jaw of Piltdown man. The anterior symphyseal surface is scarcely less vertical than that of Heidelberg man. The posterior symphyseal surface in living

anthropoids differs from that of modern man in possessing a pronounced posterior prolongation of the lower border, which joins together the two halves of the mandible, and so forms the well-known *simian shelf* and above it a deep genial impression for the attachment of the tongue musculature. In this character, *Eoanthropus dawsoni* scarcely differs from the anthropoids, especially the chimpanzee; but this new fossil betrays no evidence of such a shelf, the lower border of the mandible having been massive and rounded after the fashion of the mandible of *Homo heidelbergensis*.

FIG. 4.—Norma basalis of *Australopithecus africanus* aligned on the Frankfort horizontal.

That hominid characters were not restricted to the face in this extinct primate group is borne out by the relatively forward situation of the foramen magnum. The position of the basion can be assessed within a few millimetres of error, because a portion of the right exoccipital is present alongside the cast of the basal aspect of the cerebellum. Its position is such that the basi-prosthion measurement is 89 mm., while the basi-inion measurement is at least 54 mm. This relationship may be expressed in the form of a "head-balancing" index of 60·7. The same index in a baboon provides a value of 41·3, in an adult chimpanzee 50·7, in Rhodesian man 83·7, in a dolichocephalic European 90·9, and in a brachycephalic European 105·8. It is significant that this index, which indicates in a measure the poise of the skull upon the vertebral column, points to the assumption by this fossil group of an attitude appreciably more erect than that of modern anthropoids. The improved poise of the head, and the better posture of the whole body framework which accompanied this alteration in the angle at which its dominant member was supported, is of great significance. It means that a greater reliance was being placed by this group upon the feet as organs of progression, and that the hands were being freed from their more primitive function of accessory organs of locomotion. Bipedal animals, their hands were assuming a higher evolutionary rôle not only as delicate tactual, examining organs which were adding copiously to the animal's knowledge of its physical environment, but also as instruments of the growing intelligence in carrying out more elaborate, purposeful, and skilled movements, and as organs of offence and defence. The latter is rendered the more probable, in view, first, of their failure to develop massive canines and hideous features, and, secondly, of the fact that even living baboons and anthropoid apes can and do use sticks and stones as implements and as weapons of offence ("Descent of Man," p. 81 *et seq.*).

Lastly, there remains a consideration of the endocranial cast which was responsible for the discovery of the face. The cast comprises the right cerebral and cerebellar hemispheres (both of which fortunately meet the median line throughout their entire dorsal length) and the anterior portion of the left cerebral hemisphere. The remainder of the cranial cavity seems to have been empty, for the left face of the cast is clothed with a picturesque lime crystal deposit; the vacuity in the left half of the cranial cavity was probably responsible for the fragmentation of the specimen during the blasting. The cranial capacity of the specimen may best be appreciated by the statement that the length of the cavity could not have been less than 114 mm., which is 3 mm. greater than that of an adult chimpanzee in the Museum of the Anatomy Department in the University of the Witwatersrand, and only 14 mm. less than the greatest length of the cast of the endocranium of a gorilla chosen for casting on account of its great size. Few data are available concerning the expansion of brain matter which takes place in the living anthropoid brain between the time of eruption of the first permanent molars and the time of their becoming adult. So far as man is concerned, Owen ("Anatomy of Vertebrates," vol. iii.) tells us that "The brain has advanced to near its term of size at about ten years, but it does not usually obtain its full development till between twenty and thirty years of age." R. Boyd (1860) discovered an increase in weight of nearly 250 grams in the brains of male human beings after they had reached the age of seven years. It is therefore reasonable to believe that the adult forms typified by our present specimen possessed brains which were larger than that of this juvenile specimen, and equalled, if they did not actually supersede, that of the gorilla in absolute size.

Whatever the total dimensions of the adult brain may have been, there are not lacking evidences that the brain in this group of fossil forms was distinctive in type and was an instrument of greater intelligence that that of living anthropoids. The face of the endocranial cast is scarred unfortunately in several places (cross-hatched in the dioptographic tracing—see Fig. 5). It is evident that the relative proportion

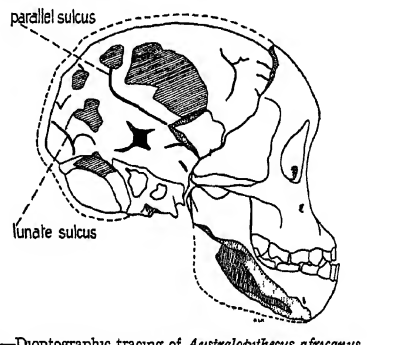

FIG. 5.—Dioptographic tracing of *Australopithecus africanus* (right side), × ⅓.

of cerebral to cerebellar matter in this brain was greater than in the gorilla's. The brain does not show that general pre- and post-Rolandic flattening characteristic of the living anthropoids, but presents a rounded and well-filled-out contour, which points to a symmetrical and balanced development of the faculties of associative memory and intelligent activity. The pithecoid type of parallel sulcus is preserved, but the sulcus lunatus has been thrust backwards towards the occipital pole by a pronounced general

bulging of the parieto-temporo-occipital association areas

To emphasise this matter, I have reproduced (Fig 6) superimposed coronal contour tracings taken at the widest part of the parietal region in the gorilla endocranial cast and in this fossil Nothing could illustrate better the mental gap that exists between living anthropoid apes and the group of creatures which the fossil represents than the flattened atrophic appearance of the parietal region of the brain (which lies between the visual field on one hand, and the tactile and auditory fields on the other) in the former and its surgent vertical and dorso-lateral expansion in the latter The expansion in this area of the brain is the more significant in that it explains the posterior *humanoid* situation of the sulcus lunatus It indicates (together with the narrow interorbital interval and human characters of the orbit) the fact that this group of beings, having acquired the faculty of stereoscopic vision, had profited beyond living anthropoids by setting aside a relatively much larger area of the cerebral cortex to

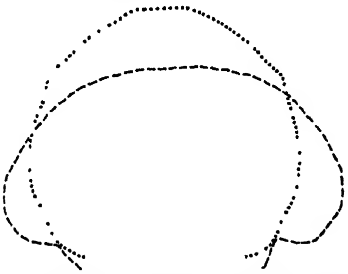

Fig 6 —Contour tracings of coronal sections through the widest part of the parietal region of the endocranial casts in Australopithecus . . . . and in a gorilla - - - -

serve as a storehouse of information concerning their objective environment as its details were simultaneously revealed to the senses of vision and touch, and also of hearing They possessed to a degree unappreciated by living anthropoids the use of their hands and ears and the consequent faculty of associating with the colour, form, and general appearance of objects, their weight, texture, resilience, and flexibility, as well as the significance of sounds emitted by them In other words, their eyes saw, their ears heard, and their hands handled objects with greater meaning and to fuller purpose than the corresponding organs in recent apes They had laid down the foundations of that discriminative knowledge of the appearance, feeling, and sound of things that was a necessary milestone in the acquisition of articulate speech

There is, therefore, an ultra-simian quality of the brain depicted in this immature endocranial cast which harmonises with the ultra-simian features revealed by the entire cranial topography and corroborates the various inferences drawn therefrom. The two thousand miles of territory which separate this creature from its nearest living anthropoid cousins is indirect testimony to its increased intelligence and mastery of its environment It is manifest that we are in the presence here of a pre-human stock, neither chimpanzee nor gorilla, which possesses a series of differential characters not encountered hitherto in any anthropoid stock This complex of characters exhibited is such that it cannot be interpreted as belonging to a form ancestral to any living anthropoid For this reason, we may be equally confident that there can be no question here of a primitive anthropoid stock such as has been recovered from the Egyptian Fayum Fossil anthropoids, varieties of Dryopithecus, have been retrieved in many parts of Europe, Northern Africa, and Northern India, but the present specimen, despite its youth, cannot be confused with anthropoids having the dryopithecid dentition Other fossil anthropoids from the Siwalik hills in India (Miocene and Pliocene) are known which, according to certain observers, may be ancestral to modern anthropoids and even to man.

Whether our present fossil is to be correlated with the discoveries made in India is not yet apparent, that question can only be solved by a careful comparison of the permanent molar teeth from both localities It is obvious, meanwhile, that it represents a fossil group distinctly advanced beyond living anthropoids in those two dominantly human characters of facial and dental recession on one hand, and improved quality of the brain on the other Unlike Pithecanthropus, it does not represent an ape-like man, a caricature of precocious hominid failure, but a creature well advanced beyond modern anthropoids in just those characters, facial and cerebral, which are to be anticipated in an extinct link between man and his simian ancestor At the same time, it is equally evident that a creature with anthropoid brain capacity, and lacking the distinctive, localised temporal expansions which appear to be concomitant with and necessary to articulate man, is no true man. It is therefore logically regarded as a man-like ape I propose tentatively, then, that a new family of *Homo-simiadæ* be created for the reception of the group of individuals which it represents, and that the first known species of the group be designated *Australopithecus africanus*, in commemoration, first, of the extreme southern and unexpected horizon of its discovery, and secondly, of the continent in which so many new and important discoveries connected with the early history of man have recently been made, thus vindicating the Darwinian claim that Africa would prove to be the cradle of mankind.

It will appear to many a remarkable fact that an ultra-simian and pre-human stock should be discovered, in the first place, at this extreme southern point in Africa, and, secondly, in Bechuanaland, for one does not associate with the present climatic conditions obtaining on the eastern fringe of the Kalahari desert an environment favourable to higher primate life It is generally believed by geologists (*vide* A W Rogers, "Post-Cretaceous Climates of South Africa," *South African Journal of Science*, vol xix, 1922) that the climate has fluctuated within exceedingly narrow limits in this country since Cretaceous times We must therefore conclude that it was only the enhanced cerebral powers possessed by this group which made their existence possible in this untoward environment

In anticipating the discovery of the true links between the apes and man in tropical countries, there has been a tendency to overlook the fact that, in the luxuriant forests of the tropical belts, Nature was supplying with profligate and lavish hand an easy and sluggish solution, by adaptive specialisation, of the

problem of existence in creatures so well equipped mentally as living anthropoids are. For the production of man a different apprenticeship was needed to sharpen the wits and quicken the higher manifestations of intellect—a more open veldt country where competition was keener between swiftness and stealth, and where adroitness of thinking and movement played a preponderating rôle in the preservation of the species Darwin has said, "no country in the world abounds in a greater degree with dangerous beasts than Southern Africa," and, in my opinion, Southern Africa, by providing a vast open country with occasional wooded belts and a relative scarcity of water, together with a fierce and bitter mammalian competition, furnished a laboratory such as was essential to this penultimate phase of human evolution

In Southern Africa, where climatic conditions appear to have fluctuated little since Cretaceous times, and where ample dolomitic formations have provided innumerable refuges during life, and burial-places after death, for our troglodytic forefathers, we may confidently anticipate many complementary discoveries concerning this period in our evolution.

In conclusion, I desire to place on record my indebtedness to Miss Salmons, Prof Young, and Mr Campbell, without whose aid the discovery would not have been made, to Mr Len Richardson for providing the photographs, to Dr Laing and my laboratory staff for their willing assistance; and particularly to Mr H Le Helloco, student demonstrator in the Anatomy Department, who has prepared the illustrations for this preliminary statement

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R.S.

6 S P. LANGLEY (1831–1906)

LANGLEY'S invention of the bolometer, and his pioneer work in the construction of the flying machine, are achievements sufficiently great to ensure a reputation which will outweigh the recollection of defects due to an exaggerated consciousness of dignity, accompanied by a marked inability to see the humorous side of things I first met Langley on the occasion of the total solar eclipse in August 1878, when he established an observing station on the top of Pike's Peak in order to obtain, if possible, a measure of the thermal radiation of the solar corona. Unfortunately, he suffered severely from mountain sickness, and had to be carried down before the day of the eclipse

In the following year, Langley visited England and expressed to me the desire to become acquainted with Clerk Maxwell I was working at the Cavendish Laboratory at the time, and was able to assure him that Maxwell would be interested to meet him as he had, in my presence, referred in very eulogistic terms to a method proposed by Langley to eliminate the personal equation in transit observations. Clerk Maxwell was just then editing Cavendish's scientific manuscripts, and conscientiously repeated every experiment that was described in them. He was specially interested in the method which Cavendish had devised for estimating the relative intensities of two electric currents, by sending the currents through his body and comparing the muscular contraction felt on interrupting the currents: "Every man his own galvanometer," as Maxwell expressed it When Langley arrived, I took him to the room where Maxwell stood in his shirt sleeves with each hand in a basin filled with water through which the current was laid. Enthusiastic about the unexpected accuracy of the experiment, and assuming that every scientific man was equally interested, he tried to persuade Langley to take off his coat and have a try. This was too much for Langley's dignity, he did not even make an effort to conceal his anger, and on leaving the laboratory he turned round and said to me: "When an English man of science comes to the United States we do not treat him like that." I explained that, had he only had a little patience and entered into the spirit of Maxwell's experiment, the outcome of his visit would have been more satisfactory

As an experimenter Langley takes a high rank, though the numerical results he derived were sometimes based on calculations that were not entirely free from defects. This led him occasionally to an optimistic judgment of their accuracy In sending out an assistant to repeat his measurement of the so-called solar constant, which expresses the total solar radiation in certain units, his final words to him were: "Remember that the nearer your result approaches the number 3, the higher will be my opinion of the accuracy of your observations" The assistant, who since then has himself attained a high position among American men of science, fortunately was a man of independent judgment and skilful both in taking and reducing his observations, with the result that the number 3 is now altogether discredited.

[1] Continued from p 163

Obituary.

DR J M ELLIS MCTAGGART

THE news of the sudden death of Dr McTaggart on January 18, at the early age of fifty-eight, came as a great shock to his numerous colleagues and friends both in Cambridge and throughout Great Britain He had, indeed, resigned his lectureship in Trinity College, Cambridge, more than a year ago in order to devote more time to literary work, but he went on giving some of the courses of lectures he had been accustomed to give, and his interest in everything that pertained to the University continued to be as keen as ever. His Friday evening lectures, open to students of all schools, have been for many years past a Cambridge institution, and various stories are related of his acuteness, resource, and ready wit in endeavouring to initiate the *profanum vulgus* in the problems of metaphysics In the affairs of his College and in those of the University he took a leading and conspicuous part, bringing to bear upon every issue a fearless independence of judgment, which won for him the

respect and esteem even of those to whom he was most opposed in opinion In politics he was strongly conservative, although here again he never allowed himself to be fettered by party ties but pursued a path distinctly his own

McTaggart was a born metaphysician. Even as a promising and favourite pupil of J M Wilson at Clifton, he is said to have displayed dialectical skill, and, on entering Trinity College, Cambridge, he began a brilliant career as an undergraduate, taking his degree as alone in the first class in the Moral Sciences Tripos of 1888. In 1891 he was elected a fellow of Trinity, having submitted as a dissertation the substance of what now forms the first four chapters of the book he published in 1896 (dedicated "to Miss Frances Power Cobbe, with much gratitude"), entitled "Studies in Hegelian Dialectic" There followed in 1901 "Studies in Hegelian Cosmology" An early draft of the last chapter on "The Further Determination of the Absolute" had been previously printed, in 1894, for "private circulation only", and in the preface to this pamphlet the author characteristically observed "I hoped that an attempt to explain my position to a few of my teachers and fellow-students might produce criticisms or refutations which should be profitable either in improving or preventing any further work on my part." Still another book on Hegel—"A Commentary on Hegel's Logic"—appeared in 1910 Here we are told that Hegel had been the chief object of McTaggart's life for twenty-one years, and he expresses his conviction that Hegel had penetrated further into the true nature of reality than any philosopher either before or after him. A more popular work, "Some Dogmas of Religion," saw the light in 1906, in it many novel views were propounded and they elicited no small amount of discussion Lastly, in 1921, McTaggart published the first volume of what was evidently intended to be his *magnum opus*, on "The Nature of Existence" It is understood that he has left the manuscript of the remaining volume in a condition that will enable it to be put into print, so that we shall fortunately not be deprived of the outcome of his maturest reflection

To indicate the distinctive features of McTaggart's speculation in a few words is scarcely possible. In the "Commentary" mentioned above he stated his belief that the next task of philosophy will be to make a fresh investigation of the nature of reality "by a dialectic method substantially, though not entirely, the same as Hegel's"; and, in his last book, he attempted to show how that task is to be fulfilled His method differs from Hegel's principally in neither accepting a *triadic* division of categories nor the partial falsehood of the lower categories In the first part of his system, that dealing with the general nature of the existent, he admitted only two empirical premises—that "something exists" and that "what exists is differentiated"—and the rest, he claimed, is entirely *a priori*, in the second part, the results obtained in the first part were to be applied to the facts which empirical observation reveals, or appears to reveal

McTaggart's idealism was not of the epistemological type, it did not rest, that is to say, upon any assumed dependence of the object known upon the knowing subject, it was what he was in the habit of calling ontological idealism, as based upon the ground that nothing exists but spirit Spirituality he defined as the quality of having content, such content being the content of one or more selves, and he held that the only existent realities are selves, groups of selves, and parts of selves Among these selves there might conceivably be one self whose volitions had the appearance of influencing the rest of the universe so profoundly that he would properly be called a god, but McTaggart could find no evidence which would make his existence probable Indeed, if the universe consist of a system of selves, and if that system be a unity which possesses spiritual significance and value, there would be, he urged, no need of a directing mind to account for the traces of order in it In any case, if the universe be a society of selves, it cannot *be* a self, and, therefore, the *Absolute* cannot be God Time, according to McTaggart, is an appearance which will ultimately merge into the timeless or the eternal Finite selves will go on existing after death until they reach the end of the time series. They cannot be said to be immortal in the ordinary sense, but their lives will not really end, although their unendingness cannot be an unending duration in time.

G DAWES HICKS

MR C. H. WORDINGHAM

MR CHARLES HENRY WORDINGHAM, who died on January 28 at the age of fifty-eight years, was well known as an electrical engineer He was born at Twickenham in 1866, and was educated at King's College School and at King's College, London He served his apprenticeship under Dr. John Hopkinson He then joined the United Telephone Company, where his work consisted mainly in assisting with the erection of telephone exchanges From 1889 to 1892 he was an engineer at the Grosvenor Gallery Generating Station of the London Electric Supply Corporation, where he was associated with Dr Ferranti and Mr Partridge in carrying out many of the pioneering experiments which led the way to such important developments. During this period also he was head of the meter testing department and devised methods of testing switches and fuses which were very useful in practical work In 1892 he again became an assistant to Dr Hopkinson and supervised the erection of the electric lighting stations at Manchester and Whitehaven In 1894 he became chief engineer to the electricity works of the Manchester Corporation, and for the next seven years devoted himself whole-heartedly to developing the station

In these early days many installations were laid down most carelessly, and the material employed was unsuitable Wordingham established a testing department at the works and insisted that all the switches, fuses and other material used by his consumers should pass a standard test He encountered great opposition at the start, but ultimately the manufacturers saw that it was to their advantage to have their devices tested. During his stay in Manchester he superintended the conversion of some 100 miles of tramways from horse to electric traction, and equipped 38 miles of new tramway

Wordingham left Manchester in 1901 to practise as a

consulting engineer, and in 1903 he was offered and accepted the post of electrical engineer-in-chief to the Admiralty Here he was responsible for the electrical equipment of all his Majesty's ships and for the electrical lighting and power used in the dockyards, including Rosyth and all the naval air stations In 1918 he left the Navy and resumed his consulting practice. He was consulted by many local authorities on traction and lighting projects He also gave expert evidence and supervised the erection of several power stations

Wordingham served for many years on the council of the Institution of Electrical Engineers and no one took a greater interest in practically all the committees He was president of the Institution in 1917 and 1918, and laid down a standard of work which subsequent presidents have found it difficult to equal He was very enthusiastic that the Institution should found a Proving House for all electrical apparatus and material, but many difficulties stood in the way During his presidentship he helped to found the Society of Radiographers, which is doing useful work He made many contributions to the technical journals and wrote a useful book on "Central Electrical Stations"

He was president of the Junior Institution of Engineers and always took the greatest interest in young engineers, doing his utmost to encourage them.

A vast amount of work was also done by Wordingham in connexion with the Engineering Standards Association, being chairman of the Electrical Sectional Committees. He also took endless pains in getting the Wiring Rules of the Institution of Electrical Engineers accepted by the authorities He has died at a comparatively early age, leaving many of the projects in which he was enthusiastically interested half finished He was very popular with his colleagues, and he will be grievously missed by every electrical engineer.

A R

MR. GEORGE ABBOTT.

GEOLOGY perhaps more than any other science needs all the assistance which careful amateurs can bring to the total sum of knowledge. Men living on the spot are of the greatest service to the official geologists when a re-survey takes place. George Abbott was one of the most painstaking of local geologists, whose help was always at the service of those who needed it Born on March 25, 1844, he was in his eighty-first year when he died on January 12 at Tunbridge Wells, where he had lived since 1878 Scattered in various publications are many of his contributions to geology, but he was particularly interested in the various rock-forms which so often resemble organised life From the magnesian limestone of Fulwell he obtained most of his specimens, and these he classified in so clear a manner that one was able to realise from his tables the series of stages by which such forms gradually grew to their familiar pseudo-organic shapes

In 1896, in conjunction with the Rev. T R. R. Stebbing, Abbott conceived the happy thought of creating a union of scientific and similar societies in the south-east of England for mutual help, and the first two of the South-Eastern Union's Annual Congresses were held at Tunbridge Wells The Union grew into a vigorous organisation and has held its annual congresses regularly ever since, whilst its annual proceedings, *The South-Eastern Naturalist*, is now accepted as a responsible scientific publication Some years later he founded a Geological Physics Society, but here apparently was a society which was not needed, for after a few years of vicissitude it ceased to exist Its work is being done by other organisations, but as a protest against the overpowering study of palæontology it performed some useful work.

Abbott had suffered a good deal during the last few years, and his favourite study, apart from his medical duties, was a great comfort in the time that he was laid by He founded the local natural history society, and supplied many specimens to the elementary schools of the borough, on the Town Council of which he served for some years He also established the Eye and Ear Hospital at Tunbridge Wells, and was Hon Surgeon from 1878 to 1886

WE regret to announce the following deaths:

Prof W A Haswell, F R S, emeritus professor of biology in the University of Sydney, and author, with the late Prof T Jeffrey Parker, of "A Text Book of Zoology," aged seventy

Dr N Kulchitsky, lecturer in histology at University College, London, and formerly professor of anatomy in the University of Kharkov, on January 29

Dr D B Spooner, deputy director of archæology in India since 1919, on January 30

Prof Hermann Schunck, a former director of the Badische Anilin- und Soda-Fabrik at Ludwigshafen, who retired in 1923, on January 8, at Solln near Munich

Current Topics and Events.

ELSEWHERE in this issue appears an account of a remarkable discovery which appears to afford *prima facie* evidence of the occurrence at a remote period in South Africa of a pre-human stock, neither chimpanzee nor gorilla, and possessing a series of characters differentiating it from any anthropoid hitherto known. Fossilised fragments from a limestone cliff formation at Taungs, 80 miles north of Kimberley, in Bechuanaland, when fitted together, have revealed a natural endocranial cast with almost the entire face of what at first sight appeared to be an anthropoid, but on closer examination is found by Prof Dart to exhibit humanoid rather than anthropoid characters The occurrence of a fossil anthropoid so far south would in itself be sufficiently remarkable, but the interest and importance of this discovery is enhanced by its remarkable divergence from the anthropoid and its approximation to the human stock Not only is this exhibited in the character of the cranium as a whole, but it is also apparent in the formation of the brain, so far as this is indicated by the endocranial cast The position of the foramen magnum, if correctly estimated, in itself would indicate that this sub-human type was well on the way towards acquiring the upright posture, and the inference of an increase in intelligence which would follow upon a

freer use of the fore-limbs is supported by the development of the association areas of the brain, which is such as to indicate a marked advance in the growth of intellect So far are we taken by Prof Dart's preliminary report and the photographs which accompany it A detailed examination of the evidence upon which his conclusions are based must await the publication of the monograph now in course of preparation Within recent years, South Africa, in the discovery of the Boskop and Rhodesian skulls, has added remarkable chapters to the history of early man, but even the interest of Rhodesian man may well be eclipsed if the claim of *Australopithecus africanus* be substantiated In this event, we shall have advanced one stage further, and that a stage of the greatest importance, in the quest for the cradle of mankind, whether that eventually prove to have been in Africa or elsewhere.

THE series of extracts from Dr Birch's "History of the Royal Society," that have been appearing in NATURE week by week during the past year, reached a conclusion with the article published last week But to Lancelot, Lancelot succeeds, "Early Science at the Royal Society" will be followed by "Early Science at Oxford," a somewhat similar series of extracts taken from the Minute Books of the Philosophical Society at Oxford between the years 1683 and 1690 By some the Oxford Society is regarded as the origin from which the Royal Society sprang Certainly it was a fully organised body, with a constitution and officers, more than ten years before the London Society received its first charter, or recorded proceedings, and even in the papers of the Royal Society itself there are occasional early references to "an ingenious assembly" meeting in Oxford The gatherings were, however, somewhat irregular owing to the fact that the members having no proper meeting-house, had to rely upon private hospitality, which made it difficult for them to accumulate books or collections, or even to arrange experiments The building of the Ashmolean Museum, with a chemical laboratory in the basement and a room for the study of natural history on the first floor, provided the accommodation that was necessary for further progress, and on October 26, 1683, "The Company meeting in ye Naturall History School, desired Dr Wallis, to take on him ye trouble of ye Chair, and appointed Mr Musgrave to take ye Minutes of their Discourse" Extracts from Mr Musgrave's minutes are now published for the first time

ON December 15 last the Foreign Secretary, in response to a question in the House of Commons asked by Mr A A Somerville, M P. for Windsor, issued a Return giving full particulars of the Boxer Indemnity (Hansard's Debates, Dec. 25, 1924, p 641, price 6d, or Christian Industrial Fellowship, 4 The Sanctuary, Westminster, price 1d) The Return enumerates not only the Powers concerned and the annual quotas paid to each, but also, in the case of remitting Powers other than Great Britain, the operative instrument and the stated purposes of remission, together with the machinery set up One notable point of this illuminating document is that all the other remitting Powers (United States, Japan, Russia, France) have defined the purposes of their remission by statute or other legislative process, leaving to committees the task of carrying into operation the purposes thus defined Another point common to all, except France, is that the purposes of remission are declared to be exclusively educational or cultural even France makes a similar declaration, but its action is postponed until the debts of a state-guaranteed bank have been discharged The remitted quotas—all of which continue until 1945—vary from 1,000,000*l* a year (Russia) to 150,000*l* (United States), that being all that remains of her original share of 260,000*l* To Britain is due 400,000*l* a year The German and the Austro-Hungarian quotas, 700,000*l* and 30,000*l* respectively, were cancelled by the allies as a result of the War The China Indemnity Bill is down for second reading in the House of Commons on February 13 The Government will, it is understood, introduce the late Government's Bill, as amended in committee If, when the Bill becomes an Act, the present meaningless description of purposes is retained, an advisory committee, and not Parliament, will determine whether "educational or other" purposes shall, for example, be interpreted to include railways It is hoped, however, that the Government may be induced so to define the purposes as to exclude this possibility, for though such a use of part of the fund might benefit a few contractors and employ a few engineers in China, it would certainly lower our prestige and alienate those for whom our remission of a just debt has been made

PROF W J DAKIN's inaugural address on "The Teaching of Biology in Secondary Schools," delivered before the Liverpool Biological Society and published in vol xxxviii, 1924, of the Society's Transactions, is a forcible pleading for the inclusion of biology as a subject of general education in school curricula Not botany alone, or zoology alone, but the study of life-processes as manifested both in plants and in animals, the mutual relations of the members of the two kingdoms, and the bearings of both on human welfare—this is the type of biology that he advocates Since in many schools botany is already taught, a large portion of the address is devoted to showing how zoology may, with a little foresight and slight expense, be likewise included in the teaching scheme Difficulties that are feared, and objections that have been raised by some teachers, are discussed, and useful suggestions are offered by which apparent obstacles may be surmounted An emphatic denial is given to the statement made in the Report of the Investigators of the Secondary School Examinations Council that "the principles of Biological Science can be better illustrated by means of botany, especially as physiology occupies a far more important part in the subject than in zoology, which does not readily lend itself to experimental treatment" There will doubtless be differences of opinion among teachers regarding the exact stage at which biology, in the full sense recommended by Prof Dakins, can most

advantageously be introduced into the school time-table, but it is to be hoped that this address will be taken to heart and widely applied in those classes to which such teaching is appropriate

DR W P DAVEY, the research physicist of the General Electric Company of America, has produced a crystallised form of copper the electric conductivity of which is 13 per cent better than that of ordinary pure electrolytic copper Prof Bridgman, of Harvard, was the first to discover that copper could be produced in relatively large crystals by the method of slowly heating it in an electric furnace and then cooling it equally slowly On December 31, Dr Davey described to the American Physical Society his success in producing copper crystals nearly an inch in diameter and six inches long These specimens could be bent without effort, but once bent they could not be straightened again This is attributed to the effect produced by the bending in upsetting the balance of the atoms of copper The crystals seem to readjust themselves into small crystals again, so that for all practical purposes it becomes a bar of ordinary copper and is equally inflexible By X-ray examination it was shown that the prepared copper was simply one large crystal, the atoms being arranged in regular rows from end to end When the crystal was hammered it lost its super-conductivity The new copper has a greater conductivity than silver At present its manufacture on a commercial scale is not feasible, but Dr Davey thinks that the time is in sight when it can be used for ordinary dynamos and conducting mains As less copper would be required for a given service, it would cheapen the cost of conduits in underground work and of the towers required for overhead conductors

SCIENTIFIC addresses by Sir Robert Hadfield are usually of a most comprehensive and enlightening kind, and that delivered by him before the Oxford University Junior Scientific Club on January 21 will delight all who see it in its published form The address was entitled "Metallurgy and its Influence on Modern Progress," and it occupies about 190 pages, of which only a portion was read and illustrated by lantern slides and moving pictures Amongst the plates in the published volume is a particularly interesting one showing Roger Bacon (1214–1292), one of the early founders of scientific thought in Oxford, the illustration represents Bacon, who wrote letters "of the Secrets of Arts and Nature" to the Paris University, presenting a book to the Chancellor of that University By kind permission of the War Office and Admiralty, Sir Robert was able to show, in the course of his address, a cinematograph picture, taken by himself and his staff, of loading and firing a 15-inch gun at the Government Proving Ground at Shoeburyness, including a view of the butt one sixteenth of a second later showing the impact on the plate, one half second later showing large numbers of fragments flying from the plate and the butt, and finally the unbroken projectile, weighing nearly one ton, after it had perforated the thick, hard-faced armour plate against which it was fired The sections devoted to metallurgy in the book cover about one hundred pages, in which Sir Robert refers to the importance of iron in antiquity, and the rise and importance of alloy steels He gives a history of the invention by himself of manganese steel, silicon steel, and other alloy steels, and refers also to the value of heat treatment and the history of the pyrometer In concluding his address Sir Robert directed attention to the importance of effort, progress and international co-operation, and suggested that there should be an annual Science Day to impress upon the community the place of science in modern life

SIR OLIVER LODGE's third talk on "Ether and Reality," delivered on February 3 under the auspices of the British Broadcasting Co from the London Station, 2LO, was devoted to the electric charge and the means by which electric charges act on each other The following are extracts from his instructive address —Discoveries of the present century have shown (what had already been suspected by Faraday and Maxwell in the last century) that electric charges are discontinuous, like matter, that they exist as separate particles, although their field or region of influence extends throughout space Moreover, electric particles or corpuscles are of two opposite kinds, which attract each other, and when very close together blot out each other's field at a distance and form a neutral combination Particles which attract each other need not fall into each other, any more than the planets fall into the sun The negative corpuscles can revolve round the positive, and thereby constitute a neutral group, with which we are familiar as an atom of matter That is what an atom of matter is, that is what is meant by saying that matter is electrically constituted The particles of opposite sign are called electrons and protons and are joined by lines of force, which represent something going on in the ether, all electrical phenomena can be expressed in terms of these lines of force Lines of force represent a state of the connecting medium which unites electrons and protons and causes their apparent attraction Similar lines account for cohesion Gravitational lines of force unite earth and moon We should always look for a medium, and we always find the ether operative in the physical universe; whether it is active in the mental universe we are not so sure Mind usually acts on mind through a physiological mechanism, whether such indirect mode of connexion is always necessary is a subject for investigation The laws of mental action may be quite different from physical laws, we should not let mechanism dominate us, for we may have to enlarge our conceptions.

"THE Mountain Structure and Geographical Relations of South-eastern Asia" formed the subject of a discourse delivered at the Royal Institution on Friday, January 30, by Prof John W Gregory. Prof. Gregory stated that the continuity of the Alpine-Himalayan system has been proved from western Europe to eastern India Its further eastward continuation, according to one view, is across central China to Bering Straits; and according to another through western Burma to Sumatra and thence along

the southern islands of the Eastern Archipelago. Its diversion from its eastward course has been attributed to the mass of Chinese Tibet, the structure of which is complex, being due to movements at two different dates. The later movements belong to the series which made the Alps and Himalaya and are geologically modern The other group is much older and is represented in Asia by the Altaid mountains The most direct proof of the Himalayan movements is afforded where rocks which, as in the salt basin of Yunnan, were not in existence when the Altaid mountains were made have been intensely folded At the end of the Altaid uplifts, the site of the Indian Ocean was covered by Gondwanaland, which extended from South America across the Old World to Australia This continent was broken up by successive subsidences, and the gulfs thus formed gradually became the Atlantic and Indian Oceans These movements were accompanied by volcanic eruptions, which deluged equatorial Africa and western India under floods of lava, while East Africa was torn asunder by the formation of the Great Rift Valley One difficulty in the explanation of these eruptions and fractures by the foundering of the floor of the Indian Ocean was the apparent absence of any corresponding phenomena on its eastern side The evidence now shows that Burma and western China were disturbed by volcanic eruptions and fractures contemporary with those of East Africa. The geographical relations of the mountains of south-eastern Asia therefore indicate that the Alpine-Himalayan system is part of a belt of crumpling of the crust where the in-sinking northern dome of the world pressed against the tropical and subtropical belt

AT a meeting of the Newcomen Society held on January 28 two historical papers were read, the first being by Mr. Hamilton, an American member, on "The Windmills of Cape Cod," while the second was by Mr David Brownlie, and was entitled "Some Notes on a Neglected Worthy, John Patison of Airdrie" John James Patison was born at Leith in April 1828 and died at Inverkeithing in July 1905 Though his youth was passed in a bookshop and a bank in Edinburgh, he was able to start a salt works at Musselburgh, and afterwards, when he had removed to Airdrie, he began experimenting on the carbonisation of shale, and near Airdrie he established the Whiterigg Chemical Works Mr Brownlie referred to him as one of the earliest practical workers in the commercial development of the Scotch shale oil industry, though its real founder was, of course, James Young The distillation of shale at Whiterigg ceased about 1864, a few years after the discovery of American petroleum Patison was also the inventor of an internal screw conveyer retort, and Mr Brownlie in his paper gives some interesting details of other inventors in the same field

THE rainfall of 1924 is dealt with in the *Meteorological Magazine* for January, but at present it is only possible to outline the general features. Over the British Isles as a whole, the year was unusually wet, the average fall was 48 5 in, which is 117 per cent of the normal. It was wetter than any year since 1903, when the rainfall over the British Isles was 52 5 in or 127 per cent of the normal In 1924 the rainfall was only slightly heavier than in 1916 and 1912, when the percentage of the average was 115 and 116 respectively. In parts of Scotland and the north of England, there were fairly large areas where the 1924 rainfall was deficient, and at Louth in Lincolnshire the rain was only 89 per cent of the average In England and Wales the rainfall for the year was 121 per cent of the average for the 35 years, 1881–1915, in Scotland it was 105 per cent, and in Ireland 122 per cent More than 140 per cent. of the average occurred on Dartmoor, on the Cotswolds, and to the north of London at Maidenhead and Chelmsford At High Wycombe, in Buckinghamshire, rain measured 38 94 in, which is 13 04 in more than the average, and is 50 per cent above the normal, it is the largest fall, with the exception of that in 1903, since records were commenced in 1846 The London rainfall, according to the Camden Square records, was 33 08 in, which is 8 61 in or 35 per cent above the normal, the largest rainfall since 1916. Rain fell in London on 188 days, and the duration of rain for the year was 539 6 hours January, May, September, and December were all very wet, whilst February and March were unusually dry

THE Hunterian oration in connexion with the Royal College of Surgeons of England will be delivered at the college on Saturday, February 14, at 4 o'clock, by Sir D'Arcy Power.

SIR WILLIAM B HARDY will deliver a lecture on "Problems presented by Films on Solid Surfaces," under the auspices of the Chemical Society, at 8 P M. on Thursday, February 26, in the lecture hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S W. Invitation has been extended to fellows of the Physical Society.

ON Tuesday, February 10, at 5 15 P M, Prof J Barcroft, Fullerian professor of physiology, begins a course of four lectures at the Royal Institution on the colour of the animal creation The Friday evening discourse on February 13 will be delivered by Dr B. Malinowski on the forces of law and order in a primitive community, and on February 20 by Prof T H Pear on acquiring muscular skill

THE Minister of Agriculture and Fisheries has appointed a permanent committee to advise the Ministry on all questions relating to agricultural meteorology The committee consists of:—Sir Napier Shaw (Chairman), Prof V. H Blackman, Mr H Corless, Mr. R. A Fisher, Mr. J C F Fryer, Mr. R H Hooker, Mr. R. G K Lempfert, Sir Thomas Middleton, Mr J. Ramsay, Mr H G Richardson, Mr W R Black, of the Ministry of Agriculture, has been appointed secretary of the committee

AT the annual council meeting of the National Union of Scientific Workers, which was held at the University of London Club on January 31, the president, Prof. G H. Hardy, announced that the efforts which the Union has been making for some

time past to obtain an increase in the Treasury grant to the Royal Society, in aid of scientific publications, have been successful. It is understood that, in the estimates for the coming financial year, the Government will make provision for an increase in this grant from 1000*l* to 2500*l* a year The Annual Report of the Executive Committee records many other activities of the Union which are of interest and benefit, not only to members, but also to the scientific world at large During the past year, three new branches have been formed, and the number of new members elected has been considerably larger than in previous years

LAST month Mr A Cobham made a flight over the Himalayas The *Times* gives some details of his journey Leaving Calcutta he reached Jalpaiguri in 3½ hours, the object of this part of the journey being to survey an air route to Darjeeling From Jalpaiguri he started his reconnaissance over the Himalayas, passing over Darjeeling at a height of some 9000 ft Flying towards Kinchinjunga, Mr Cobham experienced difficulties at about 12,000 ft, but after turning and descending, he returned and climbed without difficulty to 17,000 ft At that altitude breathing was not easy, but temperature was not so low as at 12,000 ft After taking a series of photographs of the range, Mr. Cobham returned to Jalpaiguri, having occupied only 3½ hours in his flight He believes that the whole Himalayan range could be accurately surveyed from the air at a relatively small cost, and that a flight over Mount Everest would be easy

THE arrears due to the War in the great *Index Kewensis* are being rapidly overtaken. The last pre-War Supplement, covering the years 1906–10, was published in 1913, and it was not until nine years later that it was possible to issue Supplement V, covering the years 1911–15 But Supplement VI, covering the years 1916–20, is now complete, and printing has begun at the Oxford University Press We learn from the publishers that their stock shows that a large number of sets of the work have not yet been completed to date by the addition of Supplement V. (published in 1921), and they ask us to direct the attention of librarians to this fact The value of the work, both scientific and pecuniary, is, of course, seriously impaired by the failure to complete sets; and the relatively low price at which the Supplements are issued has been made possible by the support given by librarians and learned institutions all over the world

INTERMITTENT bournes are flowing in chalk areas in the south-east of England, and the Croydon bourne is no exception It is probably not yet at its highest, but broke out as usual in the garden of the Rose and Crown, at Warlingham It is now gradually creeping up the valley More interesting is the fact that the Addington-Wickham Bourne is again out. This, after disappearing for about 33 years as a flow of any magnitude, appeared in June 1916, and is now again flowing, but it has passed its maximum The gravel-pit which has been made in its path was covered by water, but not to any depth, and it is subsiding. This bourne is not directly on the chalk, but wells up through a thickness of tertiaries, and hence does not appear until these have been saturated It is noteworthy as being in the valley which must have been at one time an upper reach of the Ravensbourne. Sodden patches which have been let down near its source seem to show that underground solution is taking place to some extent

Our Astronomical Column.

THE OPPOSITION OF EROS IN 1931 —This opposition will be much the most favourable since Eros was discovered in 1898 Dr Witt, who discovered the planet, has been engaged on the study of its perturbations up to 1931, and announces that he has now completed this work The German observatories are now making arrangements for the careful observation of stars that lie near the planet's track, as they will be required as reference stars, they are also inviting co-operation in other countries

The details of Dr Witt's work are not yet published, but the following ephemeris, based on earlier elements, gives a general idea of the conditions during the time that the planet is within 19 million miles of the earth

			R A		Decl		log Δ.
1931	Jan	5	10^h 17^m		25°	16′ N	9 306
	,,	13	10	19	17	32	9 264
	,,	21	10	16	8	45 N.	9·236
	,,	29	10	8	0	24 S	9 226
	Feb	6	9	56	8	44	9 238
	,,	14	9	45	15	31	9 265
	,,	22	9	35	20	10 S.	9 307

The maximum parallax, on Jan 29, is about 52″.

Longer preparation is possible on this occasion than at the 1901 approach, and the minimum distance is little more than half so great; thus we may hope for a corresponding increase in accuracy

THE U S A NAVAL OBSERVATORY, WASHINGTON — The report of the superintendent, Capt E T Pollock, for the year ended June 30, 1924, has been published. In the Nautical Almanac Department, special investigations have been made of the orbits of the satellites of Saturn and Neptune In the latter 1633 observations, ranging from 1889 to 1923, are included A new catalogue of 1504 standard stars has been constructed and half of it is in type The positions of the stars are a decided improvement on those in Boss's General Catalogue Most of the Nautical Almanac for 1927 is in type

The details are given of work with two transit circles and several equatorials, with these last, satellites and minor planets were observed There were two dates when the sunspot activity showed a minimum, February 1923 and the end of August 1923. Numerous observations were made with the Prime Vertical Instrument · three determinations of the constant of aberration from these observations are 20 54″, 20 55″, 20 58″. All appear to be on the large side.

The Department for Training Naval Officers includes branches for studying the gyro-compass and the magnetic compass

Research Items.

PRIMITIVE MURAL DECORATION IN SOUTHERN INDIA.—A paper by the late Dr Nelson Annandale, published in vol viii No 4 of the Memoirs of the Asiatic Society of Bengal, describes a primitive but effective form of art which is found in a Uriya village on Samal Island on the northern shore of Lake Chilka in Orissa The people of Samal speak the Uriya language, but physically they are a mixed type, some showing traces of aboriginal blood while others present a Mongoloid appearance Their culture is primitive and nominally they are Vishnuvite Hindus mostly of the Goala or cowherd caste Some of the houses are composite, sheltering several families under one roof The walls of the houses are uniformly covered with a wash of red earth forming the background of the decorations The simplest form of pattern is made by applying the three fingers dipped in chalk and water to the walls The more elaborate patterns fall into two groups, of which the character is indicated by their names One is called *janar*, a kind of maize, the other *punjha pareda*, "four coconuts," of which, however, only three can be distinguished as a rule These patterns are usually executed by men More elaborate designs also are in use, some made by women, in which birds and fishes appear. Most of the interior decorations were painted in several colours, while some of those used in internal passages were mythological Outside are certain lucky signs, such as double fish and footprints, the object of the decorations seems to be purely æsthetic.

ARCHÆOLOGICAL REMAINS IN NEW ZEALAND.—In vol ii. No 4 of the Records of the Canterbury Museum, Mr H D Skinner continues his description of the objects found in caves near Christchurch, N Z, opened in 1889, which were sent to the Otago University Museum in 1922 The material from Monck's Cave, which is situated about a mile east of the Moa-bone Point Cave previously described, although more interesting than that found in the latter, is scientifically of less value, as no record was kept of its stratification Sixteen pieces of moa bone were sent to the Museum, eight of which were worked One of the most interesting articles found was a carved bailer, the only known example from South Island, which, with a paddle, was found immediately the cave was opened It is therefore probably of later date than the moa-hunter age Its decorative *motif* of a bird's head and loop coils was not previously known from this district An outrigger float is the only New Zealand example which has been preserved Of a number of adzes, several were Polynesian in form but none of West Pacific types Among a variety of other articles were a toy canoe and paddle and a toy dog, which confirms the accounts of Maori dogs given by early travellers One of the most interesting discoveries was a series of cuttings of human hair showing a considerable variation in pigmentation, ranging from dark brown to chestnut Its very fine plaiting points to Polynesian relationship.

COLOUR FATIGUE IN THE EYE.—In a pamphlet (reprinted from *The Medical World*) Dr F. W Edridge-Green, who is special examiner and adviser to the Board of Trade on colour vision and eyesight, quotes the following passage from Dr Troland on minuthesis (that is, colour fatigue) "The general conclusion to be drawn from the work is, therefore, that minuthesis due to one colour does not alter the luminosity of another colour to a degree differing appreciably from that in which it is altered itself In other words, the change in sensitivity to brightness occasioned by stimulation of the retina is independent of the wave-length constitutions of the minuthetic and of the reacting lights This seems to imply that the luminosity function is not essentially linked with the colour or chromatic function, and stands in contradiction to the views of Abney, Ives, and others, who treat luminosity as the sum of the primary colour values of any stimulus The present results appear also to be in conflict with experimental data along similar lines published by Abney and by Burch, so that further study of the problem would seem to be required on a larger number of subjects" These conclusions are in agreement with those to which Dr Edridge-Green himself and co-workers have come (see "Physiology of Vision," p 248, Proc Roy Soc, 1912)

LARVÆ OF DECAPOD CRUSTACEA.—Notwithstanding the strange forms they frequently assume, the larvæ of decapod Crustacea have in recent years received very little attention at the hands of zoologists This is no doubt due to the great labour involved in linking up unknown forms with parents which often have a widely different appearance, and to a fear that, when all is done, little real advance will have been made in our knowledge of the group In his report on the larval decapods obtained by the British Antarctic (*Terra Nova*) Expedition (Crustacea, Part IX British Museum (Natural History) 1924 Price 15*s*) Mr Robert Gurney has shown that such studies may yield indications of great phylogenetic importance Although the numbers of known larvæ are still few in comparison with adults, it is clear from Mr Gurney's work that a classification derived from them will sometimes diverge in a striking manner from the system generally adopted This system, based mainly on the morphology of the adult decapod, is none too securely founded, and there is little doubt that a knowledge of the larval structure will be of great assistance in its revision Two of the more important conclusions that Mr Gurney has reached are that the Stenopidea should be removed to the Reptantia, and that the Thalassinidea are not homogeneous, but fall into two divisions—a Homarine series, including the Axiidæ and Callianassinæ, and an Anomuran series, including the Laomediidæ and Upogebiinæ A feature that will appeal strongly to every student of the group is that in Mr Gurney's work he is provided, for the first time, with a systematic presentation of all available information on decapod larvæ Under most of the family headings the principal larval characteristics are summarised or discussed, and there is a valuable list of references to the widely scattered literature

THE TANNING QUALITIES OF MANGROVES.—In *Indian Forest Records*, vol. x part x for 1924, Mr. J A Pilgrim has an interesting account of the mangroves of Tenasserim as a possible source of supplies of tannin The writer was appointed tannin expert to the Government of India with the idea of surveying from this point of view the mangroves of Burma, but as delay was caused in this project through the War, he has in the meanwhile carried out an investigation of the mangroves of the Sundarbans of Bengal, and thus is able to compare his Burmese results with further data obtained in more northern latitudes Pilgrim points out that whilst on the whole the mangroves of the Sundarbans and of Tenasserim show no noteworthy differences, yet on the whole, (1) the best of all the mangrove tans, and (2) the commonest of these tans, both show themselves richer in tannin in the more southern

latitude The best source of tannin is said to be *Carapa moluccensis*, the commonest *Rhizophora mucronata* This latter species has been widely collected, and Pilgrim points out that it has shown itself richer in Borneo than in the Philippines, whilst chemists in Sarawak, S Borneo, get somewhat higher yields of tannin than Pilgrim from N Borneo, and now the Burma material proves more valuable than that from Bengal The writer concludes that his present results seem to support the general thesis that mangroves increase in tannin content as they approach the Equator

OVERSEAS TRANSPORT OF APPLES —Early in 1923 a scientific expedition, consisting of Dr Ezer Griffiths, Mr A J Smith, and Mr Edgar A Griffiths, was sent by the Food Investigation Board to study problems involved in the transport of apples from Australia to England Special Report No 20 of the Board, entitled, " The Problems of Apple Transport Overseas," by Drs Kidd and West (H M S O, price 9*d* net), is a general survey and summary of the results obtained The investigation originated in an inquiry as to whether the disease known as " brown heart " could be correlated with the atmospheric conditions in the holds in which the apples were carried Four boats, representative of the different systems of marine refrigeration in use, were studied and a complete record obtained of the carbon dioxide content of the atmosphere of the holds, and of the temperature distribution in the interior of the cargo of apples One surprising result observed was the magnitude of the accidental ventilation which takes place due to leakage , calculations based on the estimated rate of production of carbon dioxide by the respiration processes of the apples and the periodic measurement of the amount of gas present in the hold show that, in one of the boats studied, about 300 cubic feet of air per day per ton of apples finds its way into the hold This was the case of a boat equipped with forced circulation of the cooled air In a boat depending on convection currents from cold brine pipes for the cooling effect, the leakage was considerably less and the accidental ventilation was only just sufficient to keep the carbon dioxide concentration below the danger limit of about 10 per cent Another important result of the expedition was to show that none of the present systems employed for the stowage of the apple cases produced a uniform temperature distribution throughout the mass This is a problem which is now being studied at the National Physical Laboratory by the aid of scale models The expedition also afforded an opportunity for observing under marine conditions the behaviour of various types of physical apparatus used in the investigation, such as electrical thermometers, carbon dioxide indicators, hygrometers, and anemometers

PETROLEUM IN THE LOST SOLDIER-FERRIS DISTRICT, WYOMING —Messrs A E Fath and G F. Moulton, of the United States Geological Survey, have recently completed their work in this interesting area of south central Wyoming, an area in which there has been active oilfield development since 1916 The results of the survey are contained in Bulletin 756 The geology conforms with that characteristic of the Big Horn Basin as a whole, and, as would be expected, Cretaceous beds constitute the most important stratigraphical and economic formations In this area of about 600 square miles, the authors have described nine domes and anticlinal folds with which oil and gas are associated , these local structures, regarded as being post-Oligocene in age, are superimposed on what is known as the Rawlins Uplift, a regional structure of early Tertiary or even older achievement. Some difficulty was experienced in mapping the district owing to the outcropping formations being much concealed by alluvial wash and blown sand, but two of the domes, Lost Soldier and Bunker Hill, are indicated topographically, especially the first, which accounts for its earlier development as an oilfield Faulting has affected the structures considerably, most dislocations cutting across the flanks of the folds , this naturally has a marked influence on the distribution of the oil-sands involved In 1921 the Lost Soldier field produced 380,811 barrels of oil from 28 wells , in the same year the Ferris Dome produced 16,740 barrels, and what is known as the " G P Dome " yielded 74,199 barrels from 3 wells. On another, the Mahoney Dome, a rich gas sand was encountered with an open-flow yield estimated at 50,000,000 cubic feet of gas per day , lightning ignited the gas and the well burned for 27 days before being extinguished, which was accomplished by exploding a 25-pound charge of dynamite close to the well-mouth, taking advantage of the momentary slowing down of the gas flow and then snuffing with steam These and other significant facts indicate that the area has decided commercial possibilities, though accessibility and questions of transport and marketing of the oil are problems which apparently are only just being solved

WIND DIRECTION, CLOUD AND VISIBILITY —The Meteorological Office, Air Ministry, in Professional Notes, Vol 3, No 36, gives a discussion " On the inter-relation of wind direction with cloud amount and visibility at Cahirciveen, Co Kerry," by Mr. L H G Dines and Mr P I Mulholland The object is to ascertain whether there is a statistical relation of sufficient magnitude to aid in forecasting the amount of cloud and visibility at night from observations in the afternoon and evening The data for cloud cover a period of ten years from 1911 to 1920 South winds are the most common, followed by south-west and west The outstanding feature is the excessive amount of cloud with south winds in each season and at different hours of the day The clearest skies occur with calms in spring and north-east winds in winter and autumn , a clear sky may be expected, with either, once in 5 or 6 times on the whole, as against once in 77 for south-west winds For the inter-relation of wind direction and visibility the data employed are for about two years, 1919 and 1920 As a rule, visibility at Cahirciveen is good, the best occurring with northerly winds, the poorest with southerly, the latter being due to the generally damp conditions prevailing with such winds The authors deal with the Beaufort letter " v," unusual visibility, as a sign of coming rain, and so far as Valencia Observatory is concerned, observations there do not support the old theory. Much more proof than observations at this special observatory will be required substantially to disprove its general applicability As a standard for normal humidity, the observations for 1886–1910 are used ; it must not be overlooked that a good many years ago the position of Valencia Observatory was shifted from an island to the mainland

METAL-CLAD ENCLOSURE OF CONDUCTORS —The tendency of modern electrical engineering is to devise automatic operation to replace manual operation, and so provide " mistake-proof " plant As the voltages of transmission, owing to the large amounts of power that have to be transported, are continually being raised, it is necessary also to devise methods of making contact with a " live " conductor a practical

impossibility. Mr. H. W. Clothier, in a paper read to the Institution of Electrical Engineers on January 22, gives a very able discussion of these and similar problems. He points out that the ideal arrangement is to enclose metallically every conductor so that it is completely inaccessible when alive. These metallic covers are connected with the earth, and if they be used over the whole supply system from the generators to the load, they provide practical immunity from burns and shocks. If this method is carried to its logical conclusion, overhead lines would have to be replaced by underground cables. The initial cost, however, of high-tension underground cables is at present in most cases prohibitive, and so compromises have to be arranged. It is also of importance that faults occurring in a transmission system should be rapidly cleared, as in several cases high-frequency currents are set up in the system, and these produce very serious electromagnetic interference with neighbouring telephone and telegraph lines. Shocks and fires from this form of interference are an appreciable "risk," and have to be taken into account. The author concludes that, for safety of the operators and continuity of the supply, the use of universal metal-clad enclosure is highly desirable. There should always be a stable neutral point on the network maintained at earth potential, and all operating mechanisms should be thoroughly trustworthy and be periodically inspected.

THE POLYMORPHIC FORMS OF IRON.—The issue of December 5, 1924, of *Die Naturwissenschaften* contains an interesting summary by F. Wever on the physics of the technical varieties of iron. The remarkable variation of properties of this material which makes it so valuable a substance depends essentially on the fact that iron can be obtained in several polymorphic forms, the behaviour of which towards carbon, which invariably accompanies such iron, is very different. The author reviews the properties of the polymorphic forms of pure iron, of which there are four, namely, α, β, γ, δ. The lattice forms of α-, β-, and δ-irons are the same and are those of a body-centred cube, while that of γ-iron is a face-centred cube. The maximum solubility for carbon is possessed by γ-iron and corresponds to 1.8 per cent at 1140°. δ-iron, which only exists between 1535° and 1410°, can dissolve 0.38 of carbon at the latter temperature. In contrast with this the solubility of carbon in β- and α-iron is extremely small. The properties of iron carbide and the relations between iron and carbon are discussed in the latter part of the paper, which concludes with a brief summary of the theory of hardening. The author favours the theory of Maurer, according to which carbon is in a condition of atomic dispersion in α-iron, the volume of which is thereby decidedly increased. The condition of strain thus induced is regarded as the cause of the exceptional hardness of such steel.

THE SILICA OF PLANTS.—D. R. Nanji and W. S. Shaw have recently found (*Chemistry and Industry* Trans., Jan. 2) that about 90 per cent. of the total silica occurring in plants is present as free silicic acid, probably in the colloidal state. The remaining 10 per cent. is in a form from which it can only be extracted after preliminary treatment with acid, probably as an ester-like combination with a polysaccharide constituent of the plant.

THE IDENTITY OF GEBER.—E. J. Holmyard, in an article on the present position of the Geber problem in *Science Progress* for January 1925, considers it definitely established that Geber is Jābir ibn Hayyān. The Latin works ascribed to Geber are probably not literal translations from the Arabic, but are works based on Arabic knowledge. There is not sufficient evidence at present definitely to state that these Latin works are genuine. A study of the works of Jābir confirms his reputation as the greatest chemist of Islam.

THE ULTRA-CENTRIFUGE.—Svedberg and Rinde, in the Journal of the American Chemical Society for December 1924, describe a new instrument, the ultra-centrifuge, for the determination of the size and the distribution of size of particles in amicroscopic colloids. It enables particles which are invisible in the ultra-microscope to be measured. The theory of the instrument is given in detail; measurements of the radius of the particles of gold sols (average radius 2.3-11.6 $\mu\mu$) made with this instrument give values 11-38 per cent. higher than those obtained by Zsigmondy's nuclear method. The nature of the protective action of gelatin upon fine-grained gold sols is also studied, minimum and maximum values for the thickness of the gelatin layer adsorbed around the gold particles being obtained.

CRYSTAL FORMATION.—The development and formation of crystals is the subject of a paper by Dr. T. V. Barker in *Chemistry and Industry* for January 16. Among the topics discussed are: lattice structure; polymorphism and isomorphism; mixed crystals; chemistry of the crystalline condition. The main lines of advance in the X-ray examination of crystals are outlined. The section on crystal mixtures is somewhat detailed. The equilibrium relations between a mixed crystal and its mother liquor are most simply illustrated by leaving out of account the variable amount of water (or other solvent) requisite for solution, and then plotting percentage composition by weight of the two constituents of the mixed crystal against their relative proportions in the solution. Two types can then be distinguished, the first of which is illustrated by mixtures of cobalt and ferrous sulphates, and the second by mixtures of potassium permanganate and perchlorate (Muthmann and Kuntze). The complete equilibrium diagram of ferrous and magnesium sulphate mixtures is given for the first time; the system belongs to the second type.

LOW TEMPERATURE TREATMENT OF BITUMINOUS MATERIALS.—T. W. S. Hutchins, at a joint meeting of the Chemical Engineering Group and the London Section of the Society of Chemical Industry on January 16, gave an account of the low temperature treatment of bituminous materials. He set out by cataloguing the conditions which must necessarily be fulfilled if such a process is to be technically successful. It would seem that these conditions are extremely stringent, for the number of such "points" (in the Wilsonian sense) reached twenty-two. He described the development of the "fusion" retort and its construction as at present used. It consists of a horizontal, revolving, externally heated retort through which the comminuted material passes. The retort contains a series of paddles on a free horizontal shaft, so that when the retort revolves, these paddles roll over in such a way as to churn up the charge, facilitating the escape of vapours and at the same time preventing the growth of accretions on the walls of the retort. It would seem that the plant is designed primarily for the recovery of liquid distillation products, and the yields obtained from a number of bituminous materials are given, but without data to indicate how far the processes are commercially successful.

Scientific Work of the Fishery Board for Scotland.[1]

AMONGST the points of scientific interest in the report for 1923 of the Fishery Board for Scotland are the facts pertaining to the continued abundance of all kinds of fishes, swarms of small haddocks especially being noted Thus the total capture was little short of that in 1919, though exceeded by that in 1920 when the rush of boats was at its height Herrings show no sign of diminution even under the unfavourable conditions of capture, the returns much exceeding those of the previous year, and almost reaching those of 1913

The work of the scientific staff includes a paper of special interest by H. Thompson on "Problems in Haddock Biology," which has already been noticed in NATURE (August 30, p 333)

Alex Bowman treats of Arnoglossus and especially of what he thinks a post-larval *A imperialis* (with a coloured figure) He remarks that *A laterna* has a similar distribution to the sole (*Solea vulgaris*), and asks what are the factors which have prevented its establishment on the East Coast of Scotland by Nature or by transplantation. The sole has always, however, occurred sparingly on the East Coast in such bays as St Andrews, and the transplantation of about 600 from Scarborough to this bay has had little effect on its abundance He points out that other species of Arnoglossus enter by the Strait of Dover and reach the Skager Rack and the Cattegat, whereas he thinks *A imperialis* must have reached the northern North Sea (where 3 young specimens were found) from the Atlantic, and that they do not survive Possibly investigations both of the life-histories of the several species and of the various currents may afford further information The efforts by the same author to locate the areas in which the herring spawn by the capture of what he terms "spawny" haddocks which "are well fed and plump of form, and have a characteristic bloom on the epiderm which masks the black pigment," seems to be somewhat far-fetched, for, whilst no less than 80 boxes of large haddocks may be caught where the herrings spawn, no more "bloom" occurs on those with their stomachs full of ova than on those caught by the liners on other grounds Again the cod, which feeds on the ova of the herring no less greedily than the haddock and even scoops up quantities of gravel with this food, presents no external change No doubt such investigations are useful on unknown ground—though the external changes are more or less imaginary

In a careful contribution on the use of the Petersen grab, A. C. Stephen perhaps makes too much of this instrument, which, though a useful adjunct to other methods of ascertaining the fauna of the sea-bottom, such as the dredge and the trawl, falls far short of the revelation a single storm will disclose on the beach. Not all the elaborate calculations of this and that species per square yard brought up by the grab will add more to our knowledge than the storm. It is curious that neither Pecten nor Nephrops (the rich food of the cod) seems to have come in the way of this instrument in the area of the Firth of Forth

An interesting digest of the summer herring fishery of 1922 is made by H Wood, whose observations and the accompanying map point to the occurrence of shoals in the same areas from June to September, the shoals perhaps differing in their composition, but still affording good catches He found that the northern large herrings spawned before the southern, and he makes remarks on the spawning areas and the times of spawning, an intensive period being the end of August

An elaborate and interesting paper is that by Prof. D'Arcy Thompson on the trawling statistics of Aberdeen from 1917 to 1921, in continuation of that issued in 1917, the period comprising two of the War years and three of unusual activity These statistics again emphasise the fact that the old East Coast fishing grounds are as productive as formerly, the value of the catches being more than doubled, and this in face of the usual pessimistic views of the sea-fisheries Whilst the post-War catches were much above the average, it is noteworthy that in 1917 the captures of codlings rose considerably, indeed were greater than in any previous year, and continued at a high level until 1920 Cod were much in the same condition Haddocks, which had been rather scarce in 1914 and 1915, went beyond pre-War levels in 1916 and continued to increase until 1919, the average per voyage being nearly four times that of 1913, and, though diminished in 1920 and 1921, were still above pre-War catches The advocates for accumulation during the War would point to this as proof of their theory, but such irregularities have often occurred previously and will occur in the future

An important addition to the scientific equipment of the Fishery Board is the new Research Laboratory, a brick building of one story, with various rooms for the staff, besides a museum and library It is within easy reach of the Bay of Nigg and Torry Harbour, Aberdeen. The Fishery Board apparently at present assumes responsibility for these researches, which do it credit, but perhaps in future it would be well if, as in the case of the Royal Society, the caution were prefixed that the Board does not accept responsibility for the views of the authors W C McINTOSH.

1 Forty-second Annual Report, Fishery Board for Scotland, being for the year 1923 (Edinburgh H M Stationery Office, 1924)

Science and the Instrument Industry.[1]

THE British Scientific Instrument Research Association is fortunate in that most of its members are, by the nature of their work, in constant contact with research, and consequently in a position to know what it implies, and understand its methods and results. Many of these participating firms have, in fact, long been in the habit of carrying out original investigations in their own laboratories They realise, therefore, the lines along which advance is possible and desirable, and, what is most important, they have had experience in formulating their problems in a scientific manner On the other hand, the research staff of the Association has learnt to envisage the problems put before it from the manufacturer's point of view, and to adapt itself to practical needs and the limitations imposed by the necessity of economic production The efficiency of this staff is very largely due to the good fortune of the Association in having as its director of research Sir Herbert Jackson, who is not only known for a variety of pioneer investigations in the realms of pure and applied science, but has also had a particularly wide experience of matters concerning instrument design, and of the psychology of the manufacturer The Association is largely a body of his shaping, and he has made it a scientific instrument for the setting and solving of problems fundamental for the industry concerned.

The sixth annual report of the Association has just

1 The Sixth Annual Report of the British Scientific Instrument Research Association, for the Year 1923–24 (London 26 Russell Square, W C 1)

appeared At the end of it will be found a list of twenty-nine research reports which have been issued to members, to whom, of course, they are confidential This is necessary to protect the participating firms against both foreign competitors and those British firms, fortunately few, which have elected to remain outside Very fittingly, both on account of the intrinsic importance of the subject to the instrument industry, and because the director is the leading authority on the chemistry of glass in Great Britain, a large number of these reports deal with problems concerning optical glass, such as the production of special glasses, including one asked for by the Admiralty, the preparation of neutral and coloured glasses, and the stabilising of polished glass surfaces, that is, the rendering of such surfaces immune from secular changes and the effects of climate This problem of stabilisation, and many of the other optical glass questions, are of particular importance to the fighting services, which depend so much on the use of optical instruments in a variety of conditions. The fighting services are represented on the Council of the Association by representatives appointed by the Department of Scientific and Industrial Research, and their presence emphasises one of the services which the Association renders to the nation Evidence of the activity of the Association on the electrical side is offered by researches on magnetic properties of materials used for galvanometer suspended systems, and on certain X-ray problems

That the importance of the work done is realised by the Department of Scientific and Industrial Research, which controls the Research Associations, is indicated by the recent history of the Association, contained in the present report. The Association has completed the first six years of its existence, and with them the period of its initial grant After investigations of the work of the Association by a special committee, including such experts as Sir Richard Glazebrook and Sir James Walker, the Department has resolved to offer an annual block grant of 10,000*l* on certain conditions which have been accepted, so that the Association has already entered upon its second grant period This period is characterised by certain administrative changes, among which the most important are those which bring the fighting services into closer touch with the Association, making them virtually members

The value of the Association to the instrument industry is not easily overestimated Apart from the actual researches which it carries out, it is often able to answer questions straightway from the knowledge which it has accumulated It acts as a centre of scientific activity, and has effectively introduced a spirit of co-operation among the participating firms, which is of the greatest promise for the future ability of the industry to excel foreign competitors The trust reposed in the director by all the members leads to a collaboration which would otherwise be quite impossible owing to trade rivalry, and there has already been an intercommunication of trade processes which has greatly benefited, for example, the various optical firms Different firms, working in close touch with the research staff, have carried out in their own works and laboratories particular researches for which they have special facilities, and the results have been freely put at the disposal of all members This policy has already led to the production of certain instruments equalling, if not surpassing, those put on the market by foreign firms which, before the War, were supposed to be unapproachable

Between the National Physical Laboratory and the Association there exists a goodwill which is evidenced by the collaboration which has already taken place over the question of testing lenses by the Twyman interferometer and over certain other problems, such as the production of resistance wire The Laboratory has always been a source of strength to the instrument maker in a variety of ways, but in the Association he has an engine which enables him to help himself in a way which no outside body can do Round the council table and in the sub-committees the members can thrash out questions both of technical design and of policy, avoid duplications of effort, and hear from one another and from outside members practical criticism and practicable suggestions, while the work of the research staff not only solves individual problems but also keeps constantly before them the high ideal of producing instruments not as good as, but better than, any yet on the market

The Botanic Garden, Copenhagen.

PROF OSTENFELD has prepared as a jubilee publication an account, referred to below,[1] of the history and resources of the Botanic Garden at Copenhagen The contents of the work include many details of historical interest, while the botanist looking around for a continental school of botany will find much useful information in its pages

The Botanic Garden, now fifty years old, is the successor of one that, dating back to the close of the eighteenth century, had become inadequate Until 1871 the site was part of the old fortifications of the city, but by 1874 about twenty-four acres were transformed The old moat, rounded off, still exists as a lake, the view-point from which one sees the features of the garden extending in pleasant vistas up the rising ground on every side Here the stately greenhouses, there the rock-garden, and in the background one or other of the scientific and public buildings which adjoin the garden In recent years the trees have been collected into a special arboretum at Soro, thus allowing space for a considerable extension of the rock-garden, and for special sections Thus in the " Danish quarter " miniature chalk cliffs harbour the plants of Moen, and on other rocks and soils the native Danish plants are seen in their normal environment

The biological section is occupied by typical growth-forms such as might be expected in the home of Eugene Warming The extensive glass-houses, in a compact block of more than 2000 square metres, include the higher palm-houses and lower ranges where tropical plants, orchids, aquatics, and other groups are housed The more noteworthy plants, indoor and outdoor, are illustrated in the jubilee volume from photographs The botanical museum shelters a mass of material, including special Danish, Arctic, and West Indian collections The list of herbaria, more than two pages, is useful for any proposing to utilise them The library of 25,000 volumes has been enriched by numerous donations The Botanical Laboratory, dating from 1890, is a spacious block which is illustrated by a plan and photographs

This home of Danish botany has been directed during the past fifty years by Joh Lange, F Didrichsen, E Warming (1885–1911), and C Raunkiaer, who was succeeded last year by C Hansen Ostenfeld. The lists of staff include W Johannsen, L Kolderup Rosenvinge, F Borgesen, and many others whose work has enriched the literature of botany Copenhagen has many advantages as a centre for the study of northern floras, and this memoir will prove a useful source of reference

1 "Botanisk Have gennem 50 Aar, 1874–1924" By C Hansen Ostenfeld Pp 101 (København G E C Gads Forlag, 1924) n p

University and Educational Intelligence.

CAMBRIDGE.—J. T. Irving, Gonville and Caius College, has been elected to the Benn W. Levy Research Studentship in Biochemistry.

The Governing Body of Emmanuel College offer to a research student, who is a candidate for the Ph.D. degree, a studentship of the value of 150*l.* a year for two years. Application should be made to the Master of Emmanuel College not later than July 31.

DUBLIN.—The Regius professor of physic in Trinity College, Dr. John Mallet Purser, has made a gift of 10,000*l.*, for the benefit of the Schools of Physic and Experimental and Natural Science, to be administered by a committee consisting of Prof. J. Joly, Prof. A. F. Dixon and Prof. W. E. Thrift. The Board of Trinity College, in gratefully accepting this most generous gift, has expressed to Prof. Purser its desire that he should associate himself with the committee in the administration of the fund. Prof. Purser has been connected with the teaching staff of Trinity College, Dublin, for 28 years, and during that period he has been to staff and students alike a source of inspiration and help, in the same way that Sir William Osler was to the scientific and medical schools at Oxford. Prof. Purser's many friends and pupils, not in Ireland alone, but in all parts of the world, will express the hope that he may long continue to hold his high position, and that he may still for many years to come preside over the School of Physic in the University to the service of which his life has been devoted.

LONDON.—A bequest of 5000*l.*, subject to certain life interests, under the will of the late Mr. Arthur Jubber, has been accepted, the interest thereon to be used for scholarships, prizes, or lectures in any advanced subject, especially chemistry, botany, mathematics, ancient, modern, and natural history.

The recognition of the London School of Economics as a School of the University in the Faculty of Arts has been extended to include the subjects of history and anthropology.

The income of the Laura Soames Trust Fund for Phonetics is to be used for an annual prize in that subject.

The degree of D.Sc. (*Chemistry*) has been conferred on Mr. George Dean (West Ham Municipal College) for a thesis entitled "The Atomic Weights of Carbon and Silver."

The election of examiners for the matriculation examination for 1926 in the subjects of ancient history, botany, geography, geometrical and mechanical drawing, German, Greek, and modern history will shortly take place. The necessary application form and particulars of the duties and remuneration of the office may be obtained from the External Registrar of the University, South Kensington, S.W.7. The completed form must be sent to reach the External Registrar by Monday, February 23, at latest.

MANCHESTER.—The Council has received from the General Electric Company of the U.S.A. the gift of an X-ray spectra apparatus for use in the Department of Physics.

The following appointments have been made:—Mr. B. A. McSwiney to be tutor and secretary to the Faculty of Medicine; Mr. B. Thomsett, assistant lecturer in electrical engineering in the Faculty of Technology; Mr. H. E. Martin, Whitworth meteorological observer.

The following resignations have been accepted:—Mr. H. Lowery, of the Department of Physics, on his appointment to a lectureship in the Technical College, Bradford; Mr. Ferris Neave, research assistant in entomology, on his appointment to a lectureship in the University of Manitoba.

OXFORD.—As was generally expected in the University, the vacancy in the Wardenship of New College has been filled by the election of the Right Hon. H. A. L. Fisher, member of Parliament for the Combined English Universities, and formerly president of the Board of Education. As a Wykehamist in the fullest sense, Mr. Fisher is certain to enter upon his duties as Warden of Wykeham's Oxford college with understanding and sympathy; while his distinguished career as an educational and administrative authority justifies the confidence which is widely felt in his ability to deal with the large questions of policy at present affecting the whole University. There is every reason to believe that Mr. Fisher, although his work as a writer and teacher has mainly lain in the department of modern history, will make his influence felt in the promotion of the best interests of natural science.

SIR AUBREY SYMONDS, second secretary of the Ministry of Health, has been appointed permanent secretary of the Board of Education, in succession to Sir Amherst Selby-Bigge, Bart.

THE annual distribution of prizes and certificates at the Sir John Cass Technical Institute, Aldgate, London, E.C.3, will take place on Tuesday, February 10. The awards will be distributed by Mr. Sydney O. Nevile, past-president of the Institute of Brewing, who will afterwards deliver an address on "The Fermentation Industries."

IN conjunction with the Development Commission the Departments of Agriculture for England and Wales and Scotland have instituted a new class of scholarships with the object of training those who desire eventually to take up posts as agricultural organisers or lecturers. The scholarships are of two years' duration, the first of which will be spent on investigational work in Great Britain and the second abroad. The scholarship allowance in the first year will normally be 200*l.*; the allowance in the second year will include provision for extra cost of travel and other expenses abroad. The Development Commissioners have approved of the following awards—the first under this scheme: H. D. Bennett (University College, Reading), F. H. Garner (University of Cambridge), V. Liversage (Harper Adams Agricultural College), T. Lewis (University College of North Wales), and A. D. Imper (Marischal College, Aberdeen).

FROM the Imperial College of Tropical Agriculture we have received a copy of its first detailed prospectus. The College, opened two years ago, trains students intending to become tropical planters, agricultural administrators or officers, or specialists, and offers facilities for study to graduates of other institutions. An important feature of the College is the provision for research and investigation which is afforded by its laboratories and fields, situated at St. Augustine, seven miles from Port-of-Spain in the Island of Trinidad. There are seven professors—of zoology and entomology, mycology and bacteriology, botany and genetics, chemistry and soil science, agriculture, economics, and sugar technology, and four lecturers, including one in veterinary science. The ordinary diploma course covers three years. Fourth year courses are provided for specialisation in branches of agricultural science or chemical technology, in particular, sugar technology, and short (one-year) self-contained courses are also provided. The College is at present non-residential.

Early Science at Oxford.

February 8, 1683-4.—Mr Desmasters gave us a farther account of ye expansion of Ice He told us, that whereas the water he made use of lately (in some experiments of this kind, mention'd in the preceeding Minutes) was a sort of rough pump-water, which he has found turn milky and turbid immediately upon ye affusion of oyl of tartar *per Deliquium*, and considering also, that ye Ice made of this Water was a sort of rarified white Ice, he was hereby inclined to try, whether River water (which would readily mix with oyl of Tartar, without ye least precipitation) would, upon freezing, be expanded to ye height of ye pump-water above mentioned In order whereunto, he fill'd a glass tube of almost an inch diameter, with river water, to ye height of 6 inches (as he had done in ye former triall,) and then putting it to freeze in a mixture of snow, and salt, it gained but $\frac{1}{8}$ of an inch, after it was frozen, whereas ye pump-water got $\frac{3}{8}$ of an inch.

Dr Plot shew'd us some *Rosemary balls*, which are of ye nature of Mr. Lister's Rust-balls, and were dug in Staffordshire, where they lye in lumps, in some of their Marl-pits Part of this stone apply'd to ye Magnet, after an hour's calcination

A letter from my Lord Bishop of Ferns and Leighlin, mentioned a discourse of his Lordship's, preliminary to ye Doctrine of Sounds included in his letter We received also a discourse from Mr William Molyneux, concerning an optical Problem, which was read, and transmitted to ye Royal Society, Mr. Bernard is desired to peruse, and consider it, as soon as it shall be returned from ye Royal Society, and give his thoughts of it to ye company

February 9, 1685-6.—An Abstract of ye book of Fishes composed by Mr Willoughby and Mr Ray, printed by ye Royal Society, was read—Mr Cole of Bristol communicated an account of his observations on ye Purple Fish, for which the thanks of the Society were ordered.

February 10, 1684-5.—A Letter from Mr Aston, dated Feb 2, was read It affirm'd (among other things) *That mortar is always without hair*, of ye truth of which we must own our selves not as yet satisfied

Ordered—That Mr Maunders, chaplain to Col. Luttrel, in Dorsetshire, Mr Thomas, minister of Chard, and Dr. Turbervile of Salisbury, be asked what information they can give of ye late cold wind, which proved so fatal in Wiltshire, and Dorsetshire, about last Christmas Also that Mr Maunders be desired, as his occasions will give him leave, to draw up, and send us, an account of ye *Laver*, an Herb growing on ye rocks near Dunster Castle

An account of ye weather here at Oxford, December, January, and February last, taken by Mr Walker, was by him presented to ye Society

A letter from Mr Cuningham, dated St Leonards College, Jan 17, 1684-5, written to Mr President, was read; It shewed his great readiness to procure us correspondents in Scotland, and contained a letter from ye reverend Dr Skene, Provost of our holy Saviour's College, in St. Andrewes, to Mr. President, concerning ye establishing a Communication of matters Philosophicall, between this Society and ye learned Doctor, and his friends It was ordered, that some of our Minutes be transcribed, to be sent ye Doctor, with the humble thanks of this Society for his compliance in this matter.

Mr Standard of Merton communicated the results of his experiments on the weights of the several parts of Hens' eggs, weighed before and after boiling The weighings were made with a pair of scales which turned with half a grain

Societies and Academies.

LONDON

Royal Society, January 29—P M S **Blackett**: The ejection of protons from nitrogen nuclei, photographed by the Wilson method Photographs have been taken of more than 400,000 alpha-ray tracks in nitrogen, using an automatic form of the Wilson condensation apparatus A source of thorium $B + C_1$ was used, giving a mixed beam of 8·6 and 5 0 cm alpha particles Among the tracks were found many normal forks due to the elastic collisions between alpha particles and nitrogen nuclei In addition, eight forks were found of a strikingly different type These abnormal forks represent the ejection of protons from nitrogen nuclei Each track branches into two arms, one of which clearly represents the track of the proton Since there is only one other arm to represent the tracks of both the residual nucleus and the alpha particle itself, the two particles must be bound together after the collision When, therefore, a proton is ejected from a nitrogen nucleus by a fast alpha particle, the alpha particle itself is captured by the residual nucleus, forming a new nucleus which should have a mass of 17 and an atomic number 8—R E **Gibbs**: The variation with temperature of the intensity of reflection of X-rays from quartz and its bearing on the crystal structure Whilst the space group to which quartz belongs is known, the positions of the atoms in the molecule remain undetermined. The oxygen atoms cannot lie in the same basal planes as do the silicon, but must interleave them at a distance d Of all the four unknown parameters, the variation of d alone will affect the intensity of reflection from the basal plane Reflection intensities measured from 0° to 800° C show that marked changes occur for all the planes at the transition point—R W **Gurney** (1) Ionisation by alpha particles in monatomic and diatomic gases In the monatomic gases—xenon, krypton, argon, neon, and helium—the amount of ionisation increases with increasing atomic number, a result to be expected from their decreasing ionisation-potentials In the diatomic gases—hydrogen, oxygen, and nitrogen—ionisation is less than in any of the monatomic gases, in spite of the high value of the ionisation-potential of helium. The ratio of the ionisation in the gases to that in air varies with the velocity of the alpha particles The question is discussed whether the value (33 volts) found by Geiger for the average expenditure of energy per pair of ions in air is applicable to ionisation near the end of the range (2) The stopping-power of gases for alpha particles of different velocities Since the stopping-power of a substance varies with the velocity of the alpha particles traversing it, the value obtained for the stopping-power of a gas by a measurement made over the whole or a large part of the range, as has usually been done, is merely an average value Small portions of the range are here selected, so that the relative stopping-power has been measured for alpha particles of high velocity, of low velocity, and of intermediate velocity, separately The relative values of the atomic stopping-powers tend to converge at the end of the range—W E **Curtis** The Fulcher hydrogen bands The Fulcher lines and Allen's additions to them have been examined with the view of finding a theoretical interpretation of them. The wave-numbers of two of the strongest lines require correction by about 0 5 cm^{-1} The differences are then sufficiently regular to provide a criterion for the genuineness of the extra lines, which are in the main confirmed The arrangement is consistent

with the view that they originate from combinations of simultaneously occurring rotation and vibration changes. New values of the molecular moments of inertia concerned are obtained which probably refer to an "excited" molecule The nuclear vibrations within the hydrogen molecule seem to be very nearly simple harmonic, which would account, in conjunction with the small moment of inertia, for the unique structure of the system as compared with other band systems The two sets of Fulcher triplets apparently originate from two molecules essentially similar in structure —W L. **Webster**. The magnetic properties of iron crystals The magnetic properties may be accounted for by the Weiss theory of molecular fields The magnitude of the molecular field is found for two crystals, giving respectively 620 and 479 gauss The magnitude of the component along any one of the crystal axes varies as $\cos^4(\psi)$, (ψ) being the angle between the axis and the direction of magnetisation The molecular field is a stable property of the crystal, and is affected considerably by the presence of impurities —A E **Ingham** and J E **Jones**: On the calculation of certain crystal potential constants and on the cubic crystal of least potential energy —E C **Stoner** and L. H **Martin**. The absorption of X-rays Two beams, defined by two slit systems, one vertically above the other, are reflected by the same crystal into two ionisation chambers The beams are first balanced A sheet of the absorbing material is then placed in the path of the upper beam, and the beams rebalanced by moving a wedge of aluminium across the path of the lower beam The well-known law $\tau/\rho = \text{const}\ Z^4\lambda^3$ holds only on the long wave-length side, or sufficiently far away on the short wave-length side of the K absorption discontinuity Neither the formula of de Broglie nor of Kramers gives correctly the variation of the magnitude of the K group with atomic numbers Measurements on the absorption co-efficients of uranium on each side of the three L absorption discontinuities show that the number of electrons associated with the L_3 level equals the sum of the numbers associated with the L_1 and L_2 levels This is in agreement with Dauvillier's result for gold — F H **Schofield** The thermal and electrical conductivities of some pure metals The maximum temperature used was 700° C The thermal conductivity of aluminium increases with rising temperature, that of nickel decreases at first, and then above 500° C increases Copper, magnesium, and zinc showed, on the whole, slight decreases of conductivity with temperature The values of Lorenz's function for copper, magnesium, and zinc were practically constant at all temperatures, that for aluminium showed a rise with increasing temperature, that for nickel showed a rise to 300° C, above which temperature it remained nearly constant except for an abnormal value at 400° C —M de **Sélincourt** On the effect of temperature on the anomalous reflection of silver The existence of a well-defined band in the ultra-violet (about 40 Å in width) at which the reflection co-efficient of silver is negligible, has been utilised to investigate the relation between the frequency of the free electrons which are responsible for the reflection and the mean distance between the particles of the metal The point of minimum reflection has been determined by a photographic method at the four temperatures −183°, −79°, 16° and 150°; the band is displaced in the direction of decreasing wave-length as the temperature is lowered, and is at the same time rendered sharper and narrower —T L **Ibbs** Thermal diffusion measurements Mixtures of each of the following pairs of gases were used. hydrogen and carbon-dioxide, hydrogen and nitrogen, nitrogen and carbon-dioxide, hydrogen and argon, helium and argon. The apparatus consists essentially of a small cold vessel maintained at uniform temperature, joined by a connecting tube to a larger vessel the temperature of which can be raised as required to about 300° C Thermal diffusion produces a difference in the distribution of the components of the mixture on the hot and cold sides, and the resulting change in composition on the cold side is measured directly by means of a katharometer, the open cell of which forms part of the cold side There is a general tendency for the gas with the heavier molecules to diffuse towards the cold side The total separation is nearly proportional to $\log T_1/T_2$ (where T_1 is the absolute temperature of the hot side, and T_2 the absolute temperature of the cold) in all cases

Optical Society, December 11 —J **Guild** (1) An equipment for visual spectro-photometry The equipment for visual spectro-photometry designed by the author and installed in the Optics Division of the National Physical Laboratory The basis of measurement is Talbot's law as applied to rotating sectors. By employing a series of sectors the whole range of effective transmission from 100 per cent to 0 01 per cent is covered by a series of fixed points, each of which corresponds to a transmission about 90 per cent of the next higher, with only a few sectors none of which is below 1 per cent in its effective transmission The gaps between the fixed points are covered by photometric wedges calibrated in terms of the sector discs The field of the instrument is of the Lummer-Brodhun contrast pattern (2) Transformation of trichromatic mixture data Algebraic methods of transforming colour mixture equations from one trichromatic system to another are described Measurements made in terms of the arbitrary working primaries of any trichromatic colorimeter can be transformed into any system of standard primaries or vice versa, without auxiliary measurements other than can be made on the instrument itself used in the normal manner —L C **Martin**: A simple microphotometer The addition of a few auxiliary parts, including a photometric comparison cube, permits an ordinary microscope to be used for finding the average density over a very small area of a photographic plate by visual methods The instrument is useful with spectrograms and star images.

January 15 —W H. **Steavenson** A peep into Sir William Herschel's workshop See NATURE, July 5, 1924, p 21 —P P **Schilovsky** Slow speed precision training gear governed from a distance The increase in precision in the training of telescopes, microscopes, etc, is possible only if an electrical device, controlled from a distant station, is applied to the moving parts The angular velocity of the training motor must correspond with that of the handle of the manipulator Standard motors in which the speed of rotation depends upon load and output cannot be used, the only system available is one where the manipulator can revolve the magnetic field of a motor's element in strict conformity with the speed and direction of a distant device at the governing station

Aristotelian Society, January 5 —G Dawes **Hicks**. The dynamic aspect of Nature The view that "force," in the sense of strain or stress, is a subjective phenomenon is devoid of justification As it is requisite to distinguish the *perception* of a colour from the *colour*, so it is requisite to distinguish the *perception* or *feeling* of a strain from the *strain* which

we perceive or feel. Though the sun is not *conscious* of a strain when it pulls the earth, it does not in the least follow that in doing so it is not subject to a strain. On the other hand, one may legitimately argue that the "mind" or "self" is as such neither subject to a strain, in the sense in which that term is used of material things, nor to be conceived as putting forth energy. In willing, as indeed in cognising, the "mind" is certainly active, but the activity is not analogous to what is signified by the phrase "exertion of force." Further, there is no ground for the contention that what we are cognisant of as "force" or "energy" is confined to organic phenomena, a supposition which would necessitate a theory of vitalism cruder than any hitherto suggested. The truth rather is that modern physics, with its conception of "lines of force" and its doctrine of energy, presupposes the reality of the factors of stress and strain in the physical world. The concept of either "force" or "energy" as an entity *per se* is doubtless a pseudo-concept; but the notion of mass and energy as inseparably combined would seem to be a necessity for physical theory. The attempt to conceive of energy as the one physical reality and of matter as a derivative therefrom results simply in the materialisation of energy. A quantum of energy becomes to all intents and purposes a materialised body, although matter is supposed to be dispensed with. The paper concluded by criticising certain consequences which have been thought to follow from the general theory of relativity.

Mineralogical Society, January 20.—**K. Yardley**: An X-ray examination of calcium formate. The orthorhombic bipyramidal unit cell contains 8 asymmetric molecules. The dimensions are $a=10.19$ Å, $b=13.41$ Å, $c=6.27$ Å. The structure is founded on the Bravais lattice Γ_0, and belongs to the space-group Q_h^5.—**John Parry** and **F. E. Wright**: Afwillite, a new hydrous calcium silicate from Dutoitspan mine, Kimberley, South Africa. This mineral was found by Mr. A. F. Williams as large water-clear crystals. These are monoclinic. Analyses give the formula $3CaO.2SiO_2.3H_2O$ or $2H_2CaSiO_4.Ca(OH)_2$. It has a slight alkaline reaction and is completely decomposed by dilute hydrochloric acid. Optical and crystallographic data are given in detail.—**P. N. Chirvinsky**: Tyuyamunite from the Tyuya-Muyun radium mine in Fergana. A review is given of the literature on the copper, vanadium, and uranium ores at this locality. The mineral tyuyamunite, $CaO.2UO_3.V_2O_5.mH_2O$, is related to carnotite, having calcium in place of potassium. The microscopical characters of the minute orthorhombic crystals are described.—**L. J. Spencer**: International agreement in mineralogical and crystallographical nomenclature. With a small amount of "give and take" in different countries much greater uniformity could be attained for mineral names. For international purposes the correct spelling of the printed word is of more importance than the correct pronunciation. There is no necessity to provide well-established mineral-names with the termination *ite*. The Millerian notation for crystal planes is the best for international use. The principal optical directions are conveniently given by α, β, γ, corresponding with the three principal indices of refraction.

EDINBURGH

Royal Society, January 12.—**E. Leonard Gill**: The Permian fish, Dorypterus. The external covering of Dorypterus consisted only of a series of large scales protecting the belly, of a curious cord-like row of spindle scales and a few scales upon the tail. The bony structures of the few examples which have been preserved, show that it belonged to the coral-fish type, that its body was exceedingly compressed and roughly circular in outline, and that its jaws, differing from those of any other known fish from the earlier deposits, show it to have developed a highly specialised mode of feeding. Its flattened body, comparative lack of scales, and limited amount of muscular tissue, necessitated that exceptional support should be derived from the bony skeleton, and hence the median plane has become filled with a development of bony spines and fin-supports, such as is scarcely equalled in any other fish. In this and other respects it shows general and remarkable convergence of adaptation to modern flattened fishes of the "John Dory" type, while in the placing of its paired fins its aspect is also modern. The investigation demands the formation of a new family for "Dorypterus," and a readjustment of its recognised place in the scale of fish evolution.—**E. A. Baker**: The law of blackening of the photographic plate at low densities. This investigation was undertaken at the Royal Observatory, Edinburgh, in order to supply the necessary physical data for a photometric study of stellar spectra. Such a study leads to the characteristic curve of radiative intensity of each star, and the determination of its temperature. But a prerequisite is the conversion from density on the photographic plate to the intensity of the illumination, for any wave-length. The instrument for measuring density is a photometer, constructed by the author, on the principle devised by Koch, in which the obscured and unobscured beams pass to two photo-electric cells and their effects are balanced against one another. The production of standard deposits representing definite ratios of the incident light was effected by means of screens pierced by standard apertures, registering upon the same spot and exposed separately or together. The values for different wave-lengths were secured by suitable colour filters. These are at present confined to the violet and the red, the filters not being sufficiently selective in the green. The results are expressed in the form of the determination of certain coefficients, equivalent to, and superseding the current statements of the inertia of the plate, development constant, and the departure from reciprocity indicated by Schwarzschild's index.—**E. L. Ince**: The vibrations of a stretched membrane with a particular law of density. Membranes the density of which diminishes according to the square of the distance from a fixed point were considered. The boundary is either circular, elliptical, or rectangular. For particular values of the constants the problem is simpler than in the case of uniform density. These simple cases are considered, and the problem is then dealt with more generally by an appeal to the Sturmian theory of differential equations.

VIENNA

Academy of Sciences, November 20.—**J. Kaess**: Fermat's great theorem and its solution.—**A. Rollett** and **A. Schmitt**: On β-amyrin from Manila elemi-resin (third contribution).—**K. Stosius** and **E. Philippi**: The course of the action of ammonia on cinnamic acid ethyl ester.—**M. Nicolic**: The influence of light on the germination of *Phacelia tanacetifolia*. The germinating power of the seeds is in part completely destroyed, in part hindered, by continued illumination. The retarding action of light increases with the strength of the illumination.—**F. Dormann**:

The epidermal glands and excretion of resin in *Alnus viridis*

November 27 —The vice-president announced the death of Sir Archibald Geikie, honorary member of the Academy —S **Meyer** Communications of the Radium Institute, No 171 Coefficients of atomic magnetism for the rare earths New determinations with the purest material from C Auer-Welsbach and for hafnium from G Hevesy Cassiopeium and hafnium are as diamagnetic as lanthanum and zirconium Tetravalent præsodymium has nearly the same atomic magnetism as trivalent cerium, and tetravalent cerium nearly the same as trivalent lanthanum The results are important for the co-ordination of electronic orbits in Bohr's atomic model —J **Kaess** Construction of the angle 1° with compasses and ruler —G **Weissenberger**, F **Schuster**, and N **Mayer** On the molecular compounds of the phenols, VI. The behaviour of naphthols, tetrahydronaphthol, and allied compounds

December 4 —H **Pettersson** Communication of the Radium Institute, No 172 The field of force of the atomic nucleus and Coulomb's law Experiments seem to show that α-particles shot at the nucleus of certain elements are not reflected but remain at the nucleus This, as well as the results obtained by Bieler, can be explained by considering the electrostatic induction between α-particle and nucleus on the basis of Coulomb's law —J **Kaess** Division of a circle into 7 and into 9 parts by ruler and compasses —L. **Holzer** Estimation of the units in a cubic number-body (Zahlkorper) —F **Raas** The crystal form of the orthoclases The growth velocities of single crystal surfaces are given numerically as relative central distances —R **Mueller**, E **Pinter**, and K **Prett** The electrochemistry of non-aqueous solutions, Communication VI Experiments on the electrolytic deposition of some metals from solutions in amyl alcohol, acetonitrile, aniline, and chinoline —B **Guth** On the chemistry of the higher fungi, Communication XVIII Investigations on the muscarine problem —J **Zellner** On the chemistry of heterotrophic phanerogams, Communication V The parasite *Prosopanche Burmeisteri* contains special tannoids —J **Pia** Remains of a land plant in the Noetsch coal strata in the eastern Gailtal Alps A new fern, Gymnoneuropteris

Official Publications Received.

United States Department of Agriculture. Department Bulletin No 1235 Life History of the Codling Moth in the Yakima Valley of Washington By E J Newcomer and W D. Whitcomb Pp 77+8 plates (Washington Government Printing Office) 15 cents

Department of the Interior Bureau of Education Bulletin, 1924, No 26 Statistics of State Universities and State Colleges for Year ending June 30, 1923 Prepared under the Supervision of Frank M Phillips. Pp 15 (Washington Government Printing Office) 5 cents

Chemistry in the Service of the State Pp 31 (Madison, Wis Department of Chemistry, University of Wisconsin)

Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending June 30th, 1924 Edited by Prof Alexander Meek Pp 121 (Cullercoats) 5*s*

Proposed National Institute for Research in Colloid Chemistry. The Need for such an Institute, the Plan for its Operation, an Argument for its Location, Letters of Commendation Pp. 104 (Madison, Wis University of Wisconsin)

University of Birmingham Executive Board of Mining Research Report on the Work of the Mining Research Laboratory, 1921–1924 Pp 32 (Birmingham)

Scientific Papers of the Institute of Physical and Chemical Research Vol 1, No 12, March Spectra of Constricted Arc of Metals By Toshio Takamine and Mitsuharu Fukuda Pp 207-216+plates 5-8. 45 sen. Vol 1, No 13, August The Fine Structure of Mercury Lines and the Isotopes By Hantaro Nagaoka, Yoshikatsu Sugiura, and Tadao Mishima Pp. 217-258+plates 9-18 2 yen (Tokyo Institute of Physical and Chemical Research, Komagome, Hongo.)

Department of Agriculture Science Bulletin No 33 Report on the Cost of Production of Maize Investigation for the Season 1921–22 By E Parrish Pp 46 (Pretoria Government Printing and Stationery Office) 6*d*

The Marine Biological Station at Port Erin (Isle of Man), being the Thirty-eighth Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool Drawn up by Prof Jas. Johnstone Pp 47 (Liverpool: University Press of Liverpool, Ltd ; London Hodder and Stoughton, Ltd) 1*s* 6*d* net

The Botanical Society and Exchange Club of the British Isles Vol 7, Part 1 Report for 1923 By G Claridge Druce Pp 366+6 plates. (Arbroath T Buncle and Co) 10*s*

Osmania University, Hyderabad Publications of the Nizamiah Observatory Astrographic Catalogue 1900 0, Hyderabad Section, (Part 2) Dec −20° to −24°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the Direction of T. P. Bhaskaran Vol 5 Measures of Rectangular Co ordinates and Diameters of 38,444 Star images on Plates with Centres in Dec −21° Pp xxxix+290 (Nizamiah Osmania University) 15 rupees , 20*s* net

Trinidad and Tobago Council Paper No 105 of 1924 Agricultural Credit Societies Report by the Registrar of Agricultural Credit Societies for the Year ended 30th June, 1924 Pp 8 (Port of Spain) 4*d*

Bulletin of the American Museum of Natural History Vol 51, Art 7. The Pectoral Limb of *Eryops* and other Primitive Tetrapods By Roy Waldo Miner Pp 145-312 (New York)

Department of the Interior Bureau of Education Bulletin, 1923, No 55 Bibliography of Educational and Psychological Tests and Measurements Compiled by Margaret Doherty and Josephine MacLatchy under the Direction of B R Buckingham Pp ix+233 (Washington Government Printing Office) 25 cents

Fifty-fifth Annual Report of the Trustees of the American Museum of Natural History for the Year 1923 Pp xxiv+269+13 plates (New York City)

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès verbaux des réunions Vol 35 Rapport Atlantique 1923 (Travaux du Comité du Plateau Continental Atlantique) (Atlantic Slope Committee) Publié avec l'aide de Dr Ed Le Danois Pp 58+11 planches (Copenhague Andr Fred Høst et fils)

Methods and Problems of Medical Education (Second Series) Pp. 11+118 (New York The Rockefeller Foundation)

Diary of Societies.

SATURDAY, FEBRUARY 7

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30 A M —L Colledge: Demonstration of Kinematograph Pictures of Cases of Facial Paralysis treated by Nerve Anastomosis —G J Jenkins Septicæmia as a Complication of Middle ear Infection

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Dr E H Fellowes The Elizabethan Ayre

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C), at 3 —Dr J R. Leeson The Evolution of Man

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at Grand Hotel, Manchester), at 4 —V C Faulkner A Psychological Examination of Foundry Life

HULL ASSOCIATION OF ENGINEERS (at Hull Municipal Technical College), at 7 15 —J Sim Recent Developments in Marine Auxiliaries

MONDAY, FEBRUARY 9.

ROYAL IRISH ACADEMY (at Dublin), at 4 15

ROYAL SOCIETY OF EDINBURGH, at 4 30 —W L Calderwood The Relation of Sea Growth to the Spawning Frequency in *Salmo salar* —Prof F J Cole A Monograph on the General Morphology of the Myxinoid Fishes based on a study of Myxine Pt 6 The Blood Vascular and Lymphatic Systems —Sir Thomas Muir The Theory of Compound Determinants from 1900 to 1920

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Prof. A T Clay The Amaru

BIOCHEMICAL SOCIETY (in Biochemical Department, University College), at 5 —H J Channon Cholesterol Synthesis in the Animal Body —G A. Harrison and H J Channon Observations on the Composition of Subcutaneous Fat in Cases of Sclerema Neonatorum —C R Harington: 3 4 5 Tri-iodophenyl-pyrollidone-carboxylic Acid —J C Drummond and K H Coward (*a*) Further Observations on the Chemical Nature of the Vitamin Fraction of Cod Liver Oil, (*b*) Ultra-violet Radiation and Growth —S Tsubura Comparison of the Reducing Properties of Plain and Striated Muscle —Dr P Haas and T G Hill An Oxygen Absorbing Mechanism in *Mercurialis perennis* and Accompanying Colour Changes —A Wormall The Tyrosinase-tyrosine Reaction the Theory of Deamination —F C Happold and H S Raper. The Supposed Deaminising Action of Tyrosinase on Amino Acids —C Rimington and H D Kay The Phosphorus of Caseinogen (Preliminary Communication)

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof V E. Negus: Some Disorders of the Larynx

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —Capt P P Eckersley and others Discussion on Broadcasting

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section), at 7 —K. Rowell Recent Developments in Solid Injection Oil Engines

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7 30 —J A. Gardner Methods of Keeping Foundry Records

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine, Comparative Medicine, Disease in Children Sections), at 8 —Dr Robertson, Dr Niven, and others Special Discussion on The Control of Tuberculosis and the Milk Supply

SURVEYORS' INSTITUTION, at 8

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —J M de Navarro Ancient Trade Routes in Europe

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W), at 8 30 —Sir Thomas Horder, Bart , and others Discussion on the Treatment of Lymphadenoma

TUESDAY, FEBRUARY 10

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (at National Institute for Medical Research), at 4 30
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof J Barcroft. The Colour of the Animal Creation (I) The Colour of Man
ROYAL SANITARY INSTITUTE, at 6 —Maj -Gen Sir Wilfred Beveridge, Dr W M Willoughby, and others · Discussion on Food and Health.
INSTITUTE OF MARINE ENGINEERS, at 6 30 —Presidential Address
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub Centre) (at the College, Loughborough), at 6 45 —S Ferguson A General Survey of the High Tension Switchgear Field
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 —F G Woollard British Methods of Continuous Production
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Informal Discussion on Domestic Electrical Apparatus.
ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group), at 7 —Conference on the Standardisation of Plate Testing Methods —Section IV The Measurement of Photographic Densities (*a*) Survey of the Present Position, (*b*) Standardisation of Photographic Densities; (*c*) Methods of Measurement Opening Paper by Dr C. F Toy —Section V The Interpretation of Results (*a*) Plate Speeds The Hurter and Driffield and other Systems, (*b*) Inadequacy of these Systems. Rôle played by the under, correct and over exposure portions of the plate curve Opening Paper by T Thorne Baker and O Bloch
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates Meeting) (at Broadgate Café, Coventry), at 7 15 —G H Day Aluminium its Alloys and their Use in the Automobile Industry
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Section) (at 207 Bath Street, Glasgow), at 7 30 —H W Taylor Three wire Direct-current Distribution Networks · Some Comparisons in Cost and Operation
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30
QUEKETT MICROSCOPICAL CLUB, at 7 30 —D J Scourfield Asymmetry among Microscopic Organisms (Presidential Address)
INSTITUTION OF MECHANICAL ENGINEERS (Swansea Meeting)

WEDNESDAY, FEBRUARY 11.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Old Colony Club, Aldwych House, W C) (Annual General Meeting), at 2 30 —A H Barker Unsettled Questions in Heating and Ventilation
ROYAL SOCIETY OF ARTS, at 4 30 —Sir J Fortescue Flannery, Bart The Diesel Engine in Navigation
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof R L Knaggs Osteitis Deformans, and its relation to Osteitis Fibrosa and Osteomalacia
BRITISH SOCIETY OF MASTER GLASS PAINTERS (at 6 Queen Square, W C), at 6 —W E Tower The 14th Century Glass of Tewkesbury and its Recent Repair
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section, jointly with the Glasgow University Alchemists' Club and Institute of Chemistry) (at Glasgow University), at 7.—R B. Pilcher Alchemists and Chemists in Art and Literature
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-on Tyne), at 7 —F H Todd The Capital Ship as affected by the Washington Conference
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Wolverhampton), at 7 30 —F G Woollard British Methods of Continuous Production
INSTITUTION OF CHEMICAL ENGINEERS (jointly with the Chemical Engineering Group of the Society of Chemical Industry) (at Institution of Mechanical Engineers), at 7 30 —O Brunler Internal Combustion Boilers —D Brownlie Steam Generation under Critical Conditions
EUGENICS EDUCATION SOCIETY (at Royal Society), at 8 30 —Dr B Malinowski Mate Selection in Primitive Society

THURSDAY, FEBRUARY 12

ROYAL SOCIETY, at 4 30.—H. Muir Evans A Contribution to the Anatomy and Physiology of the Air Bladder and Weberian Ossicles in Cyprinidæ —J S Huxley Studies on Amphibian Metamorphosis, II —*To be read in title only* —Prof A. Dendy An Orthogenetic Series of Growth Forms in certain Tetraxonid Sponge-Spicules —Dr C E Walker The Meiotic Phase in Triton (*Molge vulgaris*) —W. E Alkins *Clausilia bidentata* (Strom) and *Cl cravenensis* (Taylor) A Statistical Enquiry into the Relationship of two Similar Species
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg The Properties and Structure of Quartz (III)
ROYAL AERONAUTICAL SOCIETY, at 5 30 —Col F Searle The Maintenance of Commercial Aircraft
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Sections), at 5 30 —Dr A. F MacCallan Ophthalmology in Egypt —Capt W H Dye Schistosomiasis and Splenomegaly in Nyasaland
INSTITUTE OF MARINE ENGINEERS, at 6 30
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7 15 —Dr J Newton Friend Iron in Antiquity
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub - Centre) (at University College, Dundee), at 7 30 —Prof A. R Fulton The Utilisation of Tides for the Production of Power.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre) (at Trinity College, Dublin), at 7 45 —J H Shaw The Services of the Electrical Engineer in the Post Office
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 8 —Annual General Meeting —Dr A Barr Presidential Address
OIL AND COLOUR CHEMISTS' ASSOCIATION (at 8 St Martin's Place, W.C), at 8 —A. A Drummon Synthetic Resins —R. G Browning The Painting of Ships
SOCIETY OF DYERS AND COLOURISTS (Bradford Junior Branch) (at Bradford) —W White Wool Printing

FRIDAY, FEBRUARY 13.

DIESEL ENGINE USERS' ASSOCIATION (at Engineers' Club, Coventry Street), at 3 30 —P A Holliday Submarine Engines and High-speed Heavy-oil Engine Electric Generating Sets
ROYAL DUBLIN SOCIETY, at 4 30
ROYAL ASTRONOMICAL SOCIETY, at 5 —Annual General Meeting —Prof Eddington, Dr Jackson, Mrs Maunder, and Prof Milne The Progress of Astronomy —Prof Fowler and Prof Newall The Meeting at Cambridge of the International Astronomical Union —Dr Dreyer Tycho Brahe's Observations, Methods, and Results
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5 —Annual General Meeting —F E Smith A System of Electrical Measurements (Presidential Address)
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof S Cade Regional Anæsthesia
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Discussion on Gear Production Machinery
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —M Adams Concerning Children and Photography
INSTITUTE OF METALS (Swansea Local Section) (at Swansea University College), at 7 15 —Dr H Moore Season Cracking and its Prevention
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Swansea), at 7 30 —C. A Seyler Microscopic Structure of Coals
JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —L Pendred: Milestones in the Development of the Prime-mover Locomotive.
INSTITUTE OF METALS (Sheffield Local Section, jointly with the Sheffield Metallurgical Association and other Societies) (at 198 West Street, Sheffield), at 7 30 —Dr C H Lander Fuel and its Efficient Utilisation
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle on-Tyne), at 7 30 —J W Hobson The Internal-combustion Locomotive
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Dr B. Malinowski The Forces of Law and Order in a Primitive Community
SOCIETY OF DYERS AND COLOURISTS (Scottish Section) —I E Weber: Hydrogen Peroxide and Bleaching
SOCIETY OF DYERS AND COLOURISTS (Manchester Junior Branch) (at Manchester) —K H Saunders A Paper
INSTITUTION OF MECHANICAL ENGINEERS (Leeds Meeting)

SATURDAY, FEBRUARY 14

ROYAL INSTITUTION, at 3 —W Rothenstein The Artist's Relation to Social and Religious Life (I)
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 —Sir D'Arcy Power · Hunterian Oration
INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers), at 7 30 —V C Faulkner Some Notes on Refractory Materials

PUBLIC LECTURES.

SATURDAY, FEBRUARY 7

HORNIMAN MUSEUM (Forest Hill), at 3 30 —R P G Denman The Development of Modern Radio Communication

MONDAY, FEBRUARY 9

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —Dr E B. Behrens. International Labour Organisation
BIRKBECK COLLEGE, at 5 30 —Dr G G Coulton Chapters in Medieval Education (II) Song and Grammar Schools
KING'S COLLEGE, at 5 30 —S Smith The Nature and Influence of Babylonian Literature
UNIVERSITY COLLEGE, at 5 30 —Lt -Commdr E. Sutton Buddhism (Succeeding Lecture on February 16)

TUESDAY, FEBRUARY 10

KING'S COLLEGE, at 5 30 —Dr E Bevan The Hebrew and Greek Idea of God with special reference to Philo of Alexandria
UNIVERSITY COLLEGE, at 5 30 —Dr C F Sonntag Man's Place in Nature (I) (Succeeding Lecture on February 24)
SIR JOHN CASS TECHNICAL INSTITUTE, at 8 —S O Nevile · The Fermentation Industries
UNIVERSITY OF LEEDS, at 8 —Dr W H. Pearsall. Age and Development of Moorland Peat

WEDNESDAY, FEBRUARY 11.

ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE (Physiology Department) (6 Giltspur Street, E C), at 5 —Dr J M Duncan Scott The Medullary Centres (I) (Succeeding Lectures on February 18, 25, March 4)
LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —J Adams The Principles of Design as applied to Pots and Pans
KING'S COLLEGE, at 5 30 —Sir Thomas Arnold · Arab Travellers and Merchants, A D 1000–1500

THURSDAY, FEBRUARY 12

KING'S COLLEGE, at 5 30 —Prof W E Soothill China's Contribution to Western Civilisation
CENTRAL LIBRARY, 598 Fulham Road, at 8 —W P Westell Regional Survey.

FRIDAY, FEBRUARY 13

KING'S COLLEGE, at 5 30 —Prof E Prestage Vasco da Gama and the Discovery of the Sea Route to India.

SATURDAY, FEBRUARY 14

HORNIMAN MUSEUM (Forest Hill), at 3 30 —B Lovett Natural History in Folk lore

NATURE

SATURDAY, FEBRUARY 14, 1925.

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Editorial and Publishing Offices

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Preservatives in Foods.

THE difficulty of drawing inferences of value in practical life from experimental work on animals or from observation on man could not be better illustrated than in the vexed question as to the legitimacy of allowing preservatives, especially boron preparations, in human foods. It is known that these preparations, when given steadily and persistently to animals, provoke renal inflammation; it is commonly agreed, notwithstanding occasional medical testimony to the contrary, that they may be irritant to the human alimentary tract, and that they should be barred for young children, for invalids, and for sick persons. It is also agreed that the elimination of a single dose of boric acid is slow, occupying five or six days, and that, therefore, most of us who live in towns are probably never free from boric acid in our systems from youth to old age. It is, furthermore, common knowledge that boric acid or its salts are used largely in cream, butter, liquid eggs, margarine, potted meats, and are dusted over imported bacon and ham; and that a person indulging in a varied diet may not impossibly, day by day, take an amount of boric acid which, even by the defendants of boron preservatives in food, would be regarded as inadvisable, if not actually injurious.

These and like considerations were before the Departmental Committee of 1900 and the more recent committee, the interim and final reports of which were summarised in the issues of NATURE for September 20 and December 13, 1924.

The Committees also had before them the important consideration that the use of boron preparations is not unlikely to foster the continuance of less cleanly processes of food preparation and to conceal incipient and possibly dangerous stages of decomposition of food. In this connexion, it is noteworthy that the prohibition of any preservative in milk has proved most successful, and has doubtless led to increased cleanliness in its production, transport, and storage. It has also been associated with increased use of pasteurisation, which may in some measure permit the continuance of relatively unsatisfactory production of milk; but, even so, pasteurised milk or cream represents a hygienic advance upon boricised milk or cream. It is not surprising, therefore, that the recent Committee recommends that the use of boron preparations as food preservatives should be prohibited; and the Minister of Health has indicated his intention to make draft regulations for this purpose. (For the sake of brevity, boron preservations alone are considered in this article.)

Already there are indications that the proposed regulations will not be universally approved. Sir William Pope, professor of chemistry in the University

of Cambridge, has advanced in the *Times* weighty points for consideration He regards the evidence of injury by boron preservatives as not convincing, and stresses the complexity of factors involved in human experimentation with such preparations, owing to the diverse factors concerned in the balance of health and disorder Similarly, Dr. R Hutchinson writes stating that if injury from such preparations occurs, "it has entirely escaped the notice of medical men" Also, Prof. F. W Tunnicliffe considers that in deciding against the use of boric preservatives "*a priori* argument has been drained to its dregs," and inadequate attention has been paid—as Sir William Pope had already suggested—to the danger of dearer and scarcer food, as the result of the prohibition of preservatives for perishable foods needing to be transported long distances At the least it appears to be suggested, let us postpone the prohibition of boric preservatives until the mass processes of production and transportation of perishable food have become perfected. Great waste of food is avoided by mass production. Mass production is indispensable under modern conditions of life, and the means of transport within Great Britain do not permit, it is urged, even if those from other countries permit, of cold storage and transportation, to an extent which will avoid much waste of valuable food, if preservatives are forbidden.

As indicating the way in which politics may influence hygienic control, it is suggested that the prohibition of boric preservatives in Germany is, in part at least, enforced in order to keep out Canadian and American bacon and ham. The same effect might follow from a similar prohibition in Great Britain, and so we have illustrated the struggle and conflict of motives and aims which almost necessarily arise when any reform which is theoretically desirable is proposed Motives of preferential trading may arise, the plea is entered that the proposed action will involve the wasting of much perishable food, and it is contended—as may easily be done—that the evidence of injury from the preservatives proposed to be prohibited is dubious and may even be non-existent

These are reasons for proceeding cautiously, and there need be no extravagant fear that the Ministry of Health will proceed otherwise But that the use of chemical preservatives is undesirable is, we think, indisputable, that their restriction and their extended restriction should be enforced, follows as a desirable reform, and in our view this restriction is not likely to be followed by increased scarcity of food, for we have every confidence in the ability of those concerned to improve their methods of manufacture and of transport, so as to obviate the need of any preservative except cold

In deciding a complex practical problem like this, we are bound to consider the weaker members of the community, for whom doses of boric preservatives not producing recognisable symptoms in the majority, are likely to be serious, and this consideration alone suffices, we think, to justify extension of the present regulations against food preservatives in the direction recommended by the recent Departmental Committee It has been urged that in this connexion Solon's advice to the Athenians should be followed. Have the best laws that can be kept, not the best laws that can be made But past experience has shown that gradually increasing stringency in regulating food preservatives can be enforced, and that it is associated with better processes of preparation and transportation of food, and the next steps in this direction may be expected to have similar results

Philosophical Biology.

(1) *The Study of Living Things Prolegomena to a Functional Biology* By Dr E S Russell. Pp. xx+139. (London. Methuen and Co, Ltd, 1924.) 5*s*. net.

(2) *The Passing of the Phantoms. a Study of Evolutionary Psychology and Morals.* By Prof. C. J. Patten. Pp. 95+4 plates (London: Kegan Paul and Co., Ltd, New York: E. P Dutton and Co., 1924.) 2*s*. 6*d* net

(3) *Tantalus or the Future of Man.* By Dr. F. C S. Schiller. Pp. 72 (London· Kegan Paul and Co, Ltd., 1924) 2*s*. 6*d*. net

AS the reading public gradually accepts the doctrine of evolution and its corollary, the unity of life, a demand arises for books which deal, on one hand, with the application of biological methods and ideas to human life, and on the other, with an analysis of those ideas With the narrowing of the gulf between man and the other animals, we find a quite legitimate tendency to interpret the mind of animals in terms of the human mind, and conversely But such a procedure demands enormous caution, and one can scarcely hope to find the necessary critical attitude in books which are written to defend a point of view rather than to examine all sides of a problem Yet they may justify themselves if they are sufficiently stimulating or attractive

(1) Dr Russell's book deals with the various methods by which biological problems may be attacked After a passing reference to the purely morphological point of view, he briefly examines and rejects the materialistic conception of life, and points out its failure to explain the unity of the organism Vitalism, that is, the theory that an organism consists of inert matter plus a soul or entelechy, is shown to have its own difficulties without solving those of materialism So far Dr. Russell is in agreement with J S Haldane, whom

he quotes at length But he regards Haldane's position as essentially a half-way house, also tenanted by J B Watson, to his own psychological outlook. "I know myself," he says, "as a psycho-physical unit or individuality, not as an immaterial entity acting upon an external material object, my body" It is from this point of view that he considers the behaviour of other organisms as exemplified not only by movement and secretion, but also by such activities as growth The latter half of his book is taken up with the attempt to apply this view in detail. For example, it is suggested that the growth-regulating secretion of the thyroid gland "acts not directly by virtue of its specific chemical constitution, but indirectly by virtue of its meaning or significance, being perceived or sensed in an elementary way by the organs and responded to in the functional or psychobiological sense."

Apart from his complete neglect of such difficulties for a monadistic view as are presented by fission or conjugation, for example, we are inclined to regret that Dr. Russell does not push this point of view to its logical conclusion. From a strictly psychological point of view he has no business to talk about internal secretions, and adrenaline, for example, is not an aromatic amine from his point of view, but simply an element in certain emotional states. As it is, we feel that he tends to use physics and chemistry so long as they suit him, and adopts a psychological point of view when the complexity of the physico-chemical situation becomes intolerable. But few biologists achieve consistency in their hypotheses, and we can recommend Dr Russell's book to all who are interested in the philosophical side of biology

So far man has only learned to think on two lines, one which enables us to deal with our fellow-men and the higher animals, the other with inanimate objects; but it does not follow that these are the only possible types of thought Perhaps some intermediate outlook, which preserves the unity attributed to the human individual though without his memory or foresight, may prove valuable in dealing with lowlier organisms or with our own unconscious behaviour

(2) Prof. Patten's book, after a thumb-nail sketch of evolution, plunges into animal psychology; and human attributes, such as admiration, imagination, and superstition, are assigned to birds and mammals The bearing of animal on human psychology is discussed, with special reference to the origin of human superstitions, which include all beliefs in supernatural beings. The book makes no attempt to be either scientific or exhaustive, but it is so charmingly written that we believe it will find many readers. It is clear that the author is a real lover of animals, and if his love leads him into a perhaps unduly confident belief that they are on the whole virtuous and happy, it inspires a number of delightful anecdotes of animal behaviour His religion, a sunny rather than philosophical pantheism, springs directly from his love of Nature. There is little that is novel in the book, but the author's point of view is worth restating from time to time. As a means of bringing home the reality of evolution to the average child of sixteen or so, we feel that it might be of real value in school libraries

(3) "Tantalus," who here represents humanity as a whole, is a philosopher's reaction to biology The reaction is sometimes rather naive, as when he pauses to wonder that from the biological point of view man has not evolved in the last thirty thousand years. Critics of their fellow-creatures, and particularly of the present Government, would do well to remember Lingula, which has scarcely changed in the three million or so centuries that have elapsed since Ordovician times. Dr Schiller very rightly stresses the fact that in our society those social classes which we admire most are reproducing themselves most slowly, but some of the reasons given for this fact are, to say the least, unconvincing For example, the author alleges that the advance of medicine has enormously diminished selective mortality and improved the chances of weaklings to survive and leave descendants The contrary case could be argued, for in the last two centuries epidemic diseases such as smallpox have almost disappeared, and more chronic complaints such as tuberculosis, which kill far less indiscriminately, have remained with us The question whether the differential birth-rate may not be due to certain economic features of our civilisation rather than to its philanthropy and hygiene is scarcely considered.

With regard to the traditions which constitute man's non-biological inheritance, Dr Schiller is equally gloomy Perhaps it is a too intimate acquaintance with compulsory chapel and university examinations which prompts him to ask, "How many religions have perished from ritual sclerosis, how many sciences have not been degraded into pseudo-sciences or games?" He suggests two ways out of the impasse, one being the practice of Christian ethics, the other of eugenics He believes that history has shown that humanity as at present biologically constituted will not accept the former He has more hope of the latter, provided we realise that our whole procedure is essentially experimental. He has also some confidence in the future of applied psychology The scientific reader who is interested in the reaction of biological ideas on the mind of an intelligent outsider, or wishes to see the case for eugenics briefly stated without the display of too much class or racial prejudice, would do well to buy this little essay J B S. H

The Study of Agricultural Economics.

(1) *Elements of Land Economics* By Dr Richard T. Ely and Edward W Morehouse Pp xviii+363 (New York. The Macmillan Co, 1924) 17s net.

(2) *Introduction to Agricultural Economics* By Dr Lewis Cecil Gray (Social Science Text-Books) Pp. xii+556 (New York The Macmillan Co, 1924) 12s net.

(3) *Elements of Rural Economics* By Prof. Thomas Nixon Carver Pp. v+266. (Boston and London Ginn and Co, 1924) 7s net

(4) *Farm Accounts* By C. S. Orwin. (Cambridge Farm Institute Series) Second edition, revised Pp. vi+140. (Cambridge At the University Press, 1924) 5s. net

(5) *A Short System of Farm Costing* By H R. J Holmes Pp 107. (London Oxford University Press, 1924) 6s. 6d net

(6) *Farm Accounting*. By Prof. E L Currier, Prof N. J. Lennes, and Prof A S. Merrill Pp. ix+287 (New York: The Macmillan Co, 1924) 7s net

MEN of science, in the first instance dubbed "Improvers," have been continuously at work for at least a century and a half investigating such problems as those involved in animal- and plant-husbandry, manuring, and the mechanics of agriculture Systematic study of the other, or economic, side of the industry has been undertaken only within the last decade Research work under this head may imply the compilation of elaborate cost-accounts, comparison of various methods of farming, investigation into the pros and cons of large or small-holdings or the distribution of various forms of land-tenure, inquiry into the profits accruing to each class of person engaged in the industry, study of marketing systems, and so on. Into each of these fields individual workers have gone before, but that all-important factor, continuity of effort, has, until recently, been lacking It is, for example, possible to recover the most elaborate records of the working of particular manors more than six hundred years ago, in the seventeenth century Henry Best minutely investigated what we should now describe as the "economy" of North-country farming; a hundred years ago, full statements of farm accounts kept in Norfolk and other arable counties were published.

Generally, the efforts of those responsible for these pioneer investigations were ridiculed; at best they were made the subject of acute controversy. For example, in Scotland, the publication in 1823 of an article "showing the expense and value of the produce of a Lothian farm during the late war" was thus welcomed by an anonymous farmer: "Try Mr Scott's statement by what standard you may, and inform me wherein consists its merits If it be considered a production of imagination, or of reflection, it is inferior to a nursery tale, as a work of instruction, or of utility, it is fallacious and ill-judged; as a statement of Lothian husbandry it is little short of a libel." Again, an eighteenth-century advocate of small farms thus delivered himself to a pamphleteer on the opposite side "The fiend who wrote this was in all probability never beyond the stench of the infernal abode wherein he dwells!"

If controversies are still engendered on the latter subject, and apathetic reception upon occasion rewards the efforts of Mr. Scott's successors, there is no doubt that the vast majority of agriculturists appreciate that there exists nowadays a new, and possibly valuable, means of approaching rural problems In Great Britain, since the War, successive Governments have granted increasing sums towards the extension and maintenance of services charged with investigational and advisory duties Nor is interest confined to this country, for, judging from reports emanating from Japan, the United States, Switzerland, and Denmark, it may be confidently stated that the movement towards a closer study, and therefore a better understanding, of farming conditions and rural economics is widespread. A natural corollary is the appearance of numerous publications, either dealing with the history and general principles of the subject, or confined to particular sections In both classes the United States is well represented.

(1) The first book on our list comprises an elaborate analysis of the utilisation of American soil Its authors have produced a work which is bound to be of considerable value to American students, and one that is very suggestive to those European readers who are interested in the problems raised during the transition of a vast territory from a natural condition to a state aptly illustrated by the frontispiece, entitled "Airplane view of Manhattan Island, New York City" The distribution of the various categories of soil is well described, and successive chapters deal with its utilisation, for his varying requirements, by man, his access to forest and mineral products, and the provision of credit, they also touch on what are to us such familiar and vexed questions as the taxation of "increments in land values" The volume is well produced and contains excellent diagrams and illustrations, but it contains scarcely any reference to conditions existing elsewhere.

(2) Dr Gray's book is of more general interest to European readers. The author is an official of the United States Department of Agriculture, and he has produced a book which covers a wide field, ranging

from the enunciation of general economic theories down to advice on the marketing of fruit He does not disdain reference to conditions existing in other countries, and his views on numerous rural problems will be read with respect by students therein His twenty-six chapters all conclude with "Questions on the text," which do not detract from their value, but tend to emphasise the American origin of the work itself The diagrams are excellent, particular praise must be given to the maps, produced by the author's own Department, showing the distribution of crops and of different-sized farms, a form of activity in which Great Britain has hitherto lagged behind the United States, fortunately, however, within a short time matters will have been rectified in this respect. Dr Gray's work is admirably produced, and its moderate bulk is disproportionate to the number of its pages

In (3) is found a work from the pen of a professor of political economy, which, to British ideas, is more orthodox in its treatment of the subject The general history of agriculture is not neglected, for reference is made to village communities and the manorial system, and the names of certain English writers of long ago are mentioned The author exercises considerable restraint when dealing with such contentious questions as co-operation and land-tenure, and has always at hand appeals to economic laws to enforce his arguments He has produced a small, but scholarly, work which will not only be read with interest by British economists, but will also be retained on their bookshelves Diagrams similar to those above referred to are again prominent.

(4) Mr Orwin is undoubtedly the recognised authority on farm accounts in Great Britain, and it is largely through his persistent efforts during recent years that the great advantages to be obtained from the accurate keeping of "costings" has gained wider recognition amongst the farming community In the latest edition of his book will be found clearly mapped out the procedure to be followed in farm costing The author has enumerated the various principles involved in a straightforward way which should make the volume of the greatest use to farmers and students who have had no very great experience in book-keeping The underlying principle to be grasped is that the balances of the apparently unproductive accounts (for example, labour, rent, foods, and manures) are charged against the productive accounts in the proportions in which the latter have benefited from them This involves the keeping of records of labour, both manual and horse, and of rations fed to stock Mr Orwin gives examples of appropriate labour and ration sheets, and explains the method of their analysis, complete and up-to-date cost accounts of a Gloucestershire farm add to the value of the latest edition of what is admittedly a standard work in its subject.

Mr Holmes in (5) has somewhat missed the aim of his endeavour to maintain simplicity as the primary object in preparing this volume Those farmers for whom his book is intended as a guide will be inclined to give up the task of trying to master costing principles when they read that not only must a record be kept of the number of days grazed by each class of stock, and these eventually converted into "sheep equivalents," but also that the manurial residues of foods fed on pastures must be calculated It is not to be denied that such records can be kept with advantage on certain types of holdings, but on small farms, and where live stock is of diverse types and ages, it is questionable whether the degree of accuracy with which such information could be compiled would warrant the laborious calculations involved Mr Holmes advocates the "Standard" method of valuing cows and breeding stock In this he is undoubtedly right, as in times of fluctuating prices, paper profits and losses are thus eliminated The volume contains a full set of accounts for the year 1920–21 on a dairy farm of some two hundred acres

As a text-book designed for school study in the United States, (6) can be recommended on account of the large number of exercises and "Topics for discussion" appended to each chapter The first part deals with methods of making an inventory and financial statement, the second is confined to financial accounts, while the third deals with cost accounts and methods of recording data As a treatise for British readers it is of interest in presenting arguments in favour of the adoption of general principles other than those commonly recognised in this country Some of those advocated are open to criticism For example, the authors recommend that interest on the average investment of capital in each branch of the farm should be charged against its cost, and also that a charge should be made against cost for the value of the farmer's own labour Again, in regard to home-produced foods fed on the farm, they state that "an intermediary product which may readily be marketed should be charged at its farm value and not at its cost of production Other intermediary products should be charged at their cost of production." The accepted practice in Great Britain, that of charging all intermediary products at cost price, appears to be much the sounder of the two methods The volume contains cost accounts typical of conditions in Kansas and Iowa American currency, however, and such expressions as "chores," "shelling," and "snapping corn" render them of doubtful utility outside the continent of North America.

J. A. VENN.

The Chemistry of Flour Milling.

Modern Cereal Chemistry. By D W. Kent-Jones. Pp ix+324 (Liverpool · The Northern Publishing Co, Ltd, 1924) n p.

THE chemistry of wheat flour, and the elucidation of the factors influencing the "strength" or baking quality of flours from different wheats, present problems as complicated and difficult as any to be found in food chemistry. Recent research has thrown much light on some of these problems, and the author, who is well known as an authority on flour chemistry, is to be congratulated on having given a connected and critical account of the important work done on this subject during the last few years

The English miller draws his wheat from almost every wheat-producing country in the world Many of these wheats differ enormously in their strength or ability to produce a good loaf; that is to say, a large well-risen loaf possessing a certain silky and finely vesiculated texture The author, in his chapter on the colloidal chemistry of flour, discusses the relative importance of various factors in the production of strength The actual amount of gluten present and its physical character, the degree of colloidal dispersion of gliadin and glutenin, the hydrogen ion concentration of flour and the extent to which it is "buffered," the enzymic activity of the flour and the relative amount of yeast food present, are all more or less concerned in determining strength or weakness in a flour. The author is clearly on good terms with the most recent work on the colloidal chemistry of flour, and has given in this chapter an able review of present-day knowledge in this field

It is when the author comes to the chapter on bleaching and flour improvers, on p. 165, that he treads heavily on dangerous ground He adopts wholeheartedly the attitude that the artificial bleaching and improving of flour by nitrogen peroxide, chlorine, nitrogen chloride, peroxides, persulphates, acid phosphates, etc, is completely justifiable and beneficial both to the trade and to the consumer In fact, he is at such pains to emphasise the entirely harmless character of these additions that the suspicions of the reader may well be aroused, and he may be led to inquire more closely whether the introduction of one pound of pure chlorine gas into a ton of flour is, in fact, entirely without effect on the consumer's health, whether there may not be some subtle action on the flour, affecting, ever so slightly, those vital principles which food manufacturers are never tired of claiming for their products, and whether the oft-repeated argument that no one has ever been able to prove injury to health from such additions is good enough where the most important foodstuff of all is concerned. To attempt an answer to these questions would, however, be outside the province of a reviewer

The concluding chapters dealing with conditioning, moisture in wheat and flour, and analysis of flour are excellent. The book may be warmly recommended to all interested in the chemistry of flour, on the understanding that the Report of the Departmental Committee on the Use of Preservatives and Colouring Matters in Food be glued to p 165 G W. M-W

New Measurements of Atomic Masses.

Isotopes By Dr F W Aston Second edition Pp xi+182+5 plates (London E Arnold and Co, 1924) 10s 6d net

IT is seldom that a natural philosopher has made a subject so peculiarly his own as Dr. Aston has done with the experimental investigation of isotopes At the present time, about fifty non-radioactive elements have been examined for isotopes, and all except half-a-dozen or so are among Dr. Aston's trophies It is not, apparently, so much that other workers have stood aside as that the technique is not quite so simple as a casual description of the experimental method might suggest to the inexperienced About two years ago, Dr Aston published a general account of his work since the War under the title "Isotopes," and, as was to be expected, a second edition was soon demanded, which has now made its appearance

As reference to the table of isotopes on p 107 will immediately show, in the interval of two and a half years, more than twenty new elements have been investigated for isotopes by the author, so that at the time of writing, all the elements from atomic number 1 to atomic number 39 have been worked through, and many in the range 39 to 80 A beginning has been made with the elements of the rare earth group The additions are mainly due to the development of the method of accelerated anode rays by the author A salt of the metallic element to be investigated is made into a paste with graphite, and this paste, packed into a small tube, is used as the anode, and bombarded with cathode rays The instability of the discharge consequent on the release of gas from the anode is avoided by a skilful device consisting of a subsidiary cathode and a kenotron valve It is indicative of the troublesome nature of the work that even Dr Aston himself records that when the apparatus was working sweetly, he analysed six elements successfully in as many working days, but that after it had been dismantled and set up again so as to be, apparently, exactly the same as before, he was unable to obtain any results of value for some weeks. When conditions are favourable the method gives excellent results.

The accuracy which Dr Aston now obtains in his measurements is emphasised by the fact that he is able to direct attention to a departure from the whole number rule shown by certain isotopes, notably those of tin This departure of the atomic mass from a whole number (oxygen, of course, being taken as 16) amounts to only two or three parts in a thousand, yet seems to be definitely established It does not appear possible at present to draw any very precise conclusion from this observation To avoid disturbing our ideas the effect may be attributed, in a general way, to some "close packing" of the same kind as prevents the masses of the general isotopes being whole numbers in terms of hydrogen as unity, but so little is known of the structure of complex nuclei that this is, in effect, simply a shelving of the matter until further measurements, of even higher accuracy, shall become possible The few cases of departure do not appear as such in the tables of isotopes, since a new term, "mass number," has been introduced in place of the old "mass of isotope" This is defined either as the number of protons in the nucleus or as the nearest whole number to the mass expressed in terms of oxygen as 16. both definitions amount to the same thing Since the departure is a minor matter, at any rate in the present state of our knowledge, this term is a timely one which serves, as good terms should do, to avoid inaccuracy on one hand and circumlocution on the other

The book contains many references to relevant results of other researches which have been carried out in the last two or three years, such as the work of Rutherford and Chadwick on nuclear disintegration, and the investigations of Ellis on nuclear γ-rays A rather fuller account of Fajans' speculations on relative stability of nuclei might have been welcome, since they are both more intelligible and more fruitful than most of the conjectures on this subject The detection of an isotope effect in band spectra is also discussed, but, it may be said, it is by no means certain that the boron nitride bands of Jevons, on which there has recently been discussion in the correspondence columns of NATURE, are really monoxide bands, as Mulliken wants them to be, theoretically desirable as it may be for them to be so.

The paper on which the second edition is printed is a great improvement on that of the first, and it is pleasant to be able to acknowledge, in these dear days, that the book is very reasonably priced In place of a final word of commendation, which is superfluous in this case, may be ventured the anticipation that in another year or two Dr Aston will bring out a new edition recording the remaining thirty or so non-radioactive elements as satisfactorily sorted out into their isotopes It seems very probable E. N. DA C A.

Our Bookshelf.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland a Record of the Work done in Science, Literature and Art during the Session 1923–1924 by numerous Societies and Government Institutions Compiled from official sources Forty-first annual issue Pp. vii+405 (London: C. Griffin and Co, Ltd, 1924) 15*s*. net

THE issue of this Year-Book for 1922–23 did not appear until the summer of 1924 this was somewhat late for a reference book dated for 1923 The publishers deserve our gratitude, therefore, for the promptness with which they have produced the volume for 1924 This forty-first issue has already started on a career of usefulness in our hands, which will continue until, and even after, the volume for 1925, which we hope to see in due course, has been published

Compared with last year's Year-Book, that for 1924 has been increased by sixteen pages, and we understand that seven societies have been added to the list. The increase affords some measure of the steady and healthy progress of scientific thought in Great Britain. As usual, the entries are grouped conveniently according to subject, and in each group there is a further subdivision into societies in London, the provinces, Scotland, and Ireland Under each entry is included the address, officers, meetings, conditions of membership, and publications of the society or institution in question, and in many cases the titles of papers read during the session 1923–24 follow Valuable summaries of the work during the year of such public institutions as the Royal Observatory, Greenwich, the National Physical Laboratory, and Rothamsted Experimental Station are also given. Our thanks should be added to those of the publishers to the officials whose replies to requests for detailed information have made it possible to issue such an "official" volume It was probably too late for insertion that the new address of the Royal Dublin Society at Ballsbridge, Dublin, was announced

In turning over the pages, we have found the British Photographic and the British Cast Iron Research Associations (the former not indexed), but none of the score or so of the remaining industrial research associations. The volume as it stands is, however, a valuable work of reference, which all who would keep in touch with scientific movements in the British Isles would do well to have at hand.

Auxiliary Tables of the Survey of India Fifth edition. Revised and extended by Dr J de Graaff Hunter Part 1 Graticules of Maps Pp 25 (R 1=2*s*) Part 2: Mathematical Tables Pp xiii+89 (Rs 2=4*s*) Part 3 Topographical Survey Tables Pp xxi+52 (Rs 1 8=3*s*) (Dehra Dun: Trigonometrical Survey; Part 1, 1921. Part 2, 1924 Part 3, 1923)

THE work of the Survey of India, especially in the domain of geodesy, has a world-wide reputation The first edition of these tables, which are intended to facilitate calculations connected with survey operations of all kinds, appeared so long ago as 1868 They have more than once been copied and adapted by the surveys

of other countries, though, of course, they are primarily intended to apply to the methods and scales used by the Survey of India.

Part 1 contains tables for the projection of maps falling within the latitudes embraced by India on the polyconic projection, which is that employed for the larger scale topographical maps, on the modified secant conical for small scale and general maps, and a table for the projection of the sheets of the *Carte International*, on the millionth scale, of which India has produced so many sheets Part 2 displays a series of mathematical tables in general use in survey operations, also metrical equivalents, mathematical and physical constants, geodetic data (fundamental coordinates adopted by the Survey of India), and, at the end, a few pages of useful mathematical formulæ Part 3 comprises a set of tables covering all the ground required by the topographical surveyor in his triangulation and astronomical work in the field

These tables are a considerable advance on the previous editions, and Dr Hunter deserves great credit for the way in which they have been presented They have been prepared most carefully so as to assist in the solution of almost any problem with which the surveyor is likely to be confronted The plan of publishing each part separately has added very much to their convenience for use in the field or office

Part 4, Geodetic Tables, is under compilation, and may shortly be expected, while Part 5, explaining the forms and formulæ in use in the Survey of India, is in contemplation The parts already issued contain full explanations of the tables, and also, in most cases, examples showing how the tables are used in practice

H L CROSTHWAIT

Travaux pratiques de physique générale exécutés à l'Institut de Physique de la Faculté des Sciences de Strasbourg en vue du certificat d'études supérieures de physique générale Par Prof H Ollivier Première série : Sujets de 45 manipulations, réparties en 30 séances de 4 heures Pp 104+9 planches (Paris J Hermann, 1924) 12 francs.

PROF OLLIVIER'S "Cours de physique générale" has already been the subject of favourable notice in these columns The present volume on advanced practical physics maintains the high standard we have been led to expect from the professor of physics of the University of Strasbourg It forms the first part of a treatise on the subject, and contains an account of those experiments which are repeated each year by all students attending the advanced course It is assumed that the student has already attended an elementary laboratory course, is familiar with the theory of many of the instruments, and has a fair knowledge of mathematics. Classical experiments predominate in this first volume, and the apparatus used is carefully constructed and tested Many of the instruments described are expensive, and students are expected to use them with the utmost care and to obtain results of a high degree of accuracy

The experimental hints and cautions given in the text are most valuable, and all teachers will appreciate the "recommendations générales," prominently displayed early in the course "Il ne faut toucher avec les doigts ni les parties graduées des appareils, ni les verniers, ni les poids de précision, ni les pièces optiques lentilles, miroirs, nicols, lames quart d'onde, etc" Amongst the experiments we note with special interest Rowland's method of determining the mechanical equivalent of heat, the use of the stroboscope, photography, including photography in colours by the Lumière process (in this case no directions are given), a study of elliptically polarised light (arranged by M G Foex), magnetisation of an iron ring using a fluxmeter, and the behaviour of a three-electrode lamp. A novel and interesting feature in a text-book of practical physics is the series of nine plates containing excellent photographs of the Institute of Physics of the Faculty of Sciences of Strasbourg and of the apparatus arranged for experimental work in the laboratories

H S A

An Introduction to the Study of Cytology By Dr L. Doncaster Second edition Pp xiv + 280 + 24 plates (Cambridge At the University Press, 1924) 21*s* net

IT is not always that literary ability and scientific method are wed together in sufficient degree to produce a sound scientific text-book which is, at the same time, of literary merit In recent years few famous biologists have possessed both these qualities in greater degree than the late Prof Leonard Doncaster It is, therefore, with special pleasure that we welcome the appearance of a second edition of his well-known book on "Cytology"

A monograph on any highly specialised branch of study has one great advantage over a work produced by the collaboration of a number of authors in that it possesses a greater unity of purpose, as the conception of a single mind, than could be produced by the most successful team work In this respect all must admit that Prof Doncaster's book is pre-eminent But to maintain this quality becomes a most serious difficulty to the editor of a posthumous edition This Mr Grey has admirably overcome, and, although introducing much new and useful material, has in no way detracted from the arrangement and theme of the book as a whole.

The book would have been improved, perhaps, if more space had been given to the recent extensive advances in our knowledge of the cytoplasmic inclusions. Further, we cannot help feeling that much too little space is devoted to a consideration of the various types of cells of the soma of higher forms, for almost the entire book is concerned chiefly with the reproductive processes of gametogenesis, fertilisation, and segmentation

The production of the volume is excellent, and we are pleased more especially with the illustrations We consider the edition a well-written and instructive text-book for the student and research worker

F W ROGERS BRAMBELL

A School Chemistry By O J Flecker Pp viii+238. (Oxford: At the Clarendon Press, London: Oxford University Press, 1924) 3*s* 6*d* net

AMONG the minor compensating advantages of the War period was the check given to the ever-rolling stream of text-books on elementary science, but now that paper and printing are less costly, the tide appears to be rising again; let us hope it will not overwhelm

us The young and aspiring teacher may be commended for his zeal in writing a text-book for his own use—authorship invariably impresses a literary headmaster and a governing body—but it is a question whether his time would not be better spent experimenting in the laboratory and in keeping well abreast of modern developments It is another matter if he has something really novel to say, or some new method of arrangement or presentation Unfortunately, however, originality seems to be somewhat elusive since the salad days of Ostwald, Alexander Smith, and Armstrong, and the present little work, like scores of others, does not excel in this respect The book has its merits, it is well written and particularly well spaced, the explanations are clear, and there is very little to criticise on the score of choice of experiments or of accuracy (but *any* chloride would not do instead of salt for making hydrogen chloride, p 94) The main defect is a too strict adherence to the old-fashioned, cookery-book style, the pupil who believes all he is told in this book, and performs religiously the rites prescribed, will certainly learn much that is useful and interesting, but they will not help him to acquire or develop the scientific habit of mind, a possession of far greater value than a passive knowledge of the *minutiæ* of chemical change.

Contributions from the Jefferson Physical Laboratory and from the Cruft High-Tension Electrical Laboratory of Harvard University for the Years 1922 and 1923 Vol 16 47 papers, unpaged (Cambridge, Mass Harvard University, n d) n p

This volume covers a rather longer period than is indicated in its title, the earliest paper dating from February 1921 and the latest April 1924 Ten of them are by Prof Bridgman, and deal with the properties of materials under high pressure, and several of these have been noticed in our columns Eleven others are due to G L Clark, National Research Fellow, and Prof W Duane, and deal mainly with X-rays and their use in crystal analysis In their method of investigating crystals the continuous spectrum of X-rays between 0 12 and 0 80 × 10^{-8} cm is utilised, and this allows of the use of an ordinary X-ray tube with tungsten target run at a high voltage The substance examined may be a single crystal or a powder The wave-length of a ray which is reflected at a given angle from the material is calculated from the quantum equation $Ve\lambda = hc$, where V is the least voltage applied to the tube which will cause it to emit the line λ, e is the electronic charge, h Planck's constant, and c the velocity of light The tube being run from a storage battery, V can be determined accurately Prof Lyman contributes three papers on a new vacuum spectrograph and the extreme ultra-violet spectrum

The volume maintains the high standard established by its predecessors and shows that Harvard believes in extending as well as imparting knowledge

Beach Grass By C W Townsend Pp xii + 319 + 42 plates (Boston, Mass Marshall Jones Co, 1923) 3 50 dollars

The reader who expects under this title to find a dissertation on *Psamma arenaria*, the marram grass of the coasts of the British Isles, will be disappointed, for the plant is scarcely mentioned. But the book is well worth reading It is a breezy, refreshing account of many aspects of Nature on the sand-dunes that form the coast line in the neighbourhood of Ipswich, Essex Co, Massachusetts, U S A. The author is a naturalist in the widest sense of the word, and has here set down a number of observations, illustrated by some admirable photographs, that will interest alike the serious student of physical geology, the ornithologist, the forester, and indeed all whose scientific tastes take them into the open air The description of the ice-bound sand-dune coast, and the effects of frost both on the shore and on the sea itself, and the bizarre scenery produced and most successfully illustrated, are truly wonderful In the chapters dealing with birds, biologists will find some shrewd remarks on sexual selection, and interesting accounts of the courtship of many species of birds Incidentally there are quoted authentic examples of the economic value of several birds of prey and of some of the insectivorous birds The book would perhaps be of more direct use to the British reader if the scientific names of the birds were inserted the popular American names are not very familiar on the eastern side of the Atlantic

Reason and Morals an Enquiry into the First Principles of Ethics By Dr. Israel Levine Pp xi + 177. (Glasgow MacLehose, Jackson and Co, London Simpkin, Marshall and Co, Ltd., 1924) 6*s* net

The author received the degree of D Litt from the University of Glasgow for this thesis, and though primarily dealing with a subject of philosophy, it is of peculiar scientific interest The moral law is generally held up to wonder and veneration as something utterly unintelligible on ordinary scientific principles, indicating a supernatural origin and bearing witness to a divine purpose in individual lives Dr Levine, in a clear and trenchant argument, sweeps this whole conception away The moral law is shown to be the simple condition on which human society can exist Without morals common life is impossible, and without common life the survival of the human species is impossible The existence and maintenance of social life are the inevitable expression of the life-impulse itself The essay concludes with a brief historical survey, in which it is claimed that the rational tradition in moral theory has received in modern times its complete vindication in the discoveries of psychology

Die Grundgedanken der Machschen Philosophie mit Erstveroffentlichungen aus seinen wissenschaftlichen Tagebuchern Von Prof. Dr Hugo Dingler Pp 106 (Leipzig J A Barth, 1924) 3 gold marks.

An excellent short account of the leading thought and ground-principle of the most philosophically minded of the German physicists When only fifteen, he had read from his father's library Kant's "Prolegomena" and Fechner's "Tagesansicht," and he seems even then to have formed a fixed resolution to eschew metaphysics and follow in all his researches a pure inductive method He had throughout his life an almost English aversion to apriorism and to transcendental systems of philosophy The book contains a most interesting selection from his note-books from 1880 to 1882 with memoranda for his "Mechanik" It recalls the "Common-place Book" of our own Berkeley

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications.*]

The Future of the Meteorological Office.

IN the note on Mr C J P Cave's presidential address to the Royal Meteorological Society (NATURE, January 31, p 168) Mr Cave is quoted as saying. "It is true that there is the Meteorological Office, but its position at the present time is an unfortunate one, its future is uncertain In the past the Meteorological Office was directly under the Meteorological Committee, which administered a Government grant Soon after the War, the Office was placed under the Air Ministry It seems a grave anomaly that the Meteorological Office, which deals with problems of the greatest importance to many Government departments and to many public bodies, should be solely under the direction of the Air Ministry, more especially when there is in the Department of Scientific and Industrial Research a very suitable body under which it might have been placed"

Although I am sure Mr Cave would not wish this to be taken as anything more than his own personal opinion, I must ask you to allow me to say that I do not share it Far from the Meteorological Office being in an unfortunate position, it is fortunate in being able to command, under the Air Ministry, many facilities which no other Government department could give The well-organised wireless service of the Air Ministry, with its powerful station at Kidbrooke, is available for the exchange of those wireless messages on which national and international meteorology now depends. Aeroplanes are placed at our disposal to obtain observations from the upper air, and this would be quite impossible if we were not closely connected with the Royal Air Force and the Royal Aircraft Establishment at South Farnborough

I do not understand what Mr Cave means when he says "its future is uncertain." It is true that the Meteorological Committee formerly administered a Government grant, but that grant was only 20,000*l* before the War, while the meteorological expenditure now borne on Air Votes is more than 100,000*l* The Air Ministry necessarily exercises financial supervision over this expenditure, but I have no reason whatever to complain of the result In so far as the Treasury intervenes, this is an inevitable concomitant of the appropriation of money from public funds and is applicable to all voted services alike, whether administrative or scientific.

Flying, especially civil flying, is so dependent on a good meteorological service that if the Meteorological Office were not under the Air Ministry, there would have to be a separate meteorological service for aviation Only those who have had to organise the existing complicated meteorological service for aviation with its thirteen stations on aerodromes and hourly messages along the Croydon-Continental routes can realise the close connexion necessary between the Meteorological and other departments of the Air Ministry

Because the Meteorological Office deals with problems of the greatest importance to many Government departments and to many public bodies, the Meteorological Committee has been retained to advise the Air Council on matters relating to the Meteorological Office This Committee, on which there are representatives of the Royal Society, the Royal Society of Edinburgh and six Government departments, is by no means without influence on the policy of the Meteorological Office The Committee takes special interest in the scientific work of the Office, and one representative of the Royal Society is ex-officio vice-chairman This alone would be a guarantee that the scientific work is well maintained As a matter of fact, we have more staff engaged on purely scientific work than ever before, and I am proud of the number of papers which are published yearly by my splendid scientific staff

After four years' experience as Director of the Meteorological Office under the Air Ministry, I am convinced that we could not do our work so well under any other department of Government, and I should be very sorry to have to return to a grant-in-aid

G C SIMPSON

Meteorological Office,
Air Ministry,
Adastral House, Kingsway,
London, W C 2,
February 5

High Energy γ-Ray from Thorium Disintegration Products.

IN the light of the standard measurements of the β-ray spectra of radium-B and -C by Ellis and Skinner (Roy Soc. Proc, A, vol 105, p 60, 1924) it was thought advisable to remeasure the spectra of thorium-B, -C, and -D. This has been done, using the now well-known focussing method, and the results will be published in due course The purpose of this letter is to direct attention to two lines of high energy, namely, 2 55 and 2 62 million volts, with a possible third of slightly greater energy The detection of these lines has been made possible by the preparation of thorium-B sources of greater strength than usual There is no doubt of their existence, as they appear very clearly and sharply on the photographic plate. What is most remarkable is the fact that these lines correspond to the conversion of a γ-ray of energy 2 64 million volts in the K and L levels of an atom of atomic number 82 or 83, despite the fact that their energy is some twenty-eight times as great as that of the K level of an atom of that atomic number This shows that the quantum relations hold for these high energy values in exactly the same way as they have been shown to do for the lower ones From an examination of the plates, it is seen that these lines lie beyond the region of the continuous background, and this fact may be of importance in atomic theories Another point of interest is that there appear to be no lines between these and those of an energy of about 0 8 million volts

D. H BLACK

Cavendish Laboratory, Cambridge,
January 17.

Touch and Sight *v.* The Microscope in Wool Classing and Sorting.

NOT only do the fleeces from distinct breeds of sheep vary very considerably, but also, almost without exception, each individual fleece is made up of from three to seven or eight "qualities" of fibre.

To the non-technical reader the term "quality" is something of a mystery, so it will be well clearly to define this term before proceeding further This term has no reference to the "fibre-stuff," but refers principally to the fibre diameter Thus, if q = quality number and d = fibre diameter in the fraction of an

inch, the following equations link up "quality" and "fibre diameter"

$$\text{Log } a = \frac{1}{1\ 6} (\log 1\ 52 + \log d), \tag{1}$$

or

$$d = \frac{1}{1\ 52\ q^{1\ 6}} \tag{2}$$ [1]

Taking (1) with a 58's quality, the following result is obtained

58's quality = 1/1000 in diameter

Taking (2) with a fibre of 1/1000 in diameter the following result is obtained

1/1000 = 58's quality

In List I the relationships between quality numbers 28's to 100's and fibre diameters are given

LIST I — RELATIONSHIPS BETWEEN BRADFORD QUALITY NUMBERS AND FIBRE DIAMETERS IN FRACTIONS OF AN INCH

μ ($\frac{1}{1000}$th of m m)	Bradford Quality Number	Diameter Reciprocal by Formula
		in
80 89	28's	314
65 30	32's	389
54 04	36's	470
42 69	40's	595
39 19	44's	648
36 50	46's	696
34 14	48's	744
31 95	50's	795
30 02	52's	846
28 25	54's	899
26 65	56's	953
25 23	58's	1007
23 86	60's	1064
21 52	64's	1180
19 54	68's	1299
18 66	70's	1361
15 06	80's	1686
12 48	90's	2034
10 54	100	2408

The connexion between the quality number and the fibre diameter is now quite evident; but the question at once arises as to what the quality number really represents

The quality number represents the number of hanks of 560 yards each to which one pound of the particular wool in question may be spun Thus, 58's quality conveys to the spinner the information that

58 × 560 = 32,480 yards

may be spun from one pound of this wool Thus, in a sense, the quality number represents the fineness of yarn (thread) which may be spun from any wool under consideration In actual practice it is agreed that, broadly speaking, the quality number is rather greater than the corresponding length of thread. Thus, a 58's quality wool would not, as a rule, be spun to a count finer than 50's, that is

50 × 560 = 28,000 yards per lb

Thousands of wool-classers [2] in Australia and elsewhere, and of sorters in Bradford and elsewhere, are daily classing or sorting fleeces of wool into the respective "qualities," and one or two interesting questions arise with reference to this work In the first place, Is a sorter always consistent in his sorting? Does he always class the finer wool, say in a typical merino fleece, as 80's, the medium as 70's, and the coarse as 64's? And if he is found to be doing this according to the given equation to-day, did he make the same classification last year, and will he be making the same classification next year—say, as a test case, after six months away from the sorting table? More important still, will the wool-sorter in Bradford sort his fleeces into the same qualities that the Australian wool-classer would make, and will he be equally consistent in his sorting?

The writer has recently had the opportunity of carrying out certain classing and sorting tests in Australia, and later in Bradford, which, at least in part, answer these questions On Bundure Sheep-station (New South Wales) the wool-classer was asked to select three typical qualities of wool, 68's, 64's, and 60's Later, these were measured under the microscope, and upon these measurements the "frequency curves" shown in Fig 1 were constructed and the "average diameters" of the three qualities of wools ascertained It will be noted that the

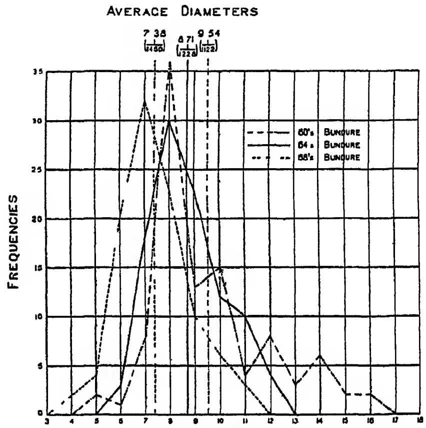

FIG 1 —Bundure "Classings"

microscope almost exactly confirms the wool-classer's relative qualities, but that so far as coincidence with List I is concerned, the Australian wool-classer is almost a quality lower than the list

Later, Camden Park (Sydney) merinos were submitted to a wool-sorter in Bradford, and he made of these wools three qualities, 80's, 70's, and 64's Again, on the sorting being tested by the microscope, it is found that the sorter is quite consistent with his own qualities, the frequency curves being given in Fig. 2. On comparing Figs 1 and 2, however, it is found that, following the microscopic measurements, approximately the same fibre diameter (1/1400 in) is stated as 68's by the Australian wool-classer and as 80's by the Bradford wool-sorter On comparing the 64's, however, it will be noted that the Australian wool-classer's 64's (Fig 1) has a fibre diameter of 1/1122 in, while the Bradford wool-sorter's 64's (Fig 2) has a diameter of 1/1311 in, *i e.* finer than the Bundure 64's (1/1228 in) Both are finer than would be expected from List I, and no doubt indicate that just as the temperature of the hand before estimating the temperature of a liquor may affect the estimate, so may touch and sight testing be affected by the exercising of these faculties just previous to the quality estimates in question

These differences may further be explained as follows The Bradford sorter is possibly sorting his wools into rather higher qualities than those prevailing in pre-War times Again, the amount of "yolk"

[1] See "Woollen and Worsted Spinning," Wilkinson's Rule, p 231 (Messrs Cassell and Co)

[2] "Classing" is the term applied to the estimation of the "quality" of the whole fleece, "sorting" is the term applied to the separation of the several qualities in one fleece

(grease, etc) in the fibre varies with different wools, and in the case of these two wools was approximately

Bundure 50 per cent loss on scouring,
Camden Park 60 per cent loss on scouring

Thus, as the micro-measurements were made after clearing with ether and the classing or sorting carried out "in the grease," certain of the differences

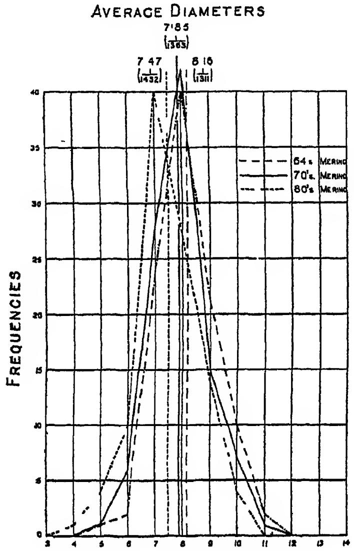

FIG 2—Bradford "Sortings"

observable may be explained Broadly speaking, the following conclusions are to be drawn

1 Wool-classers are very consistent in their "quality" estimations,

2. Wool-sorters are very consistent in their "quality" estimations,

3 Wool-classers as against wool-sorters and vice

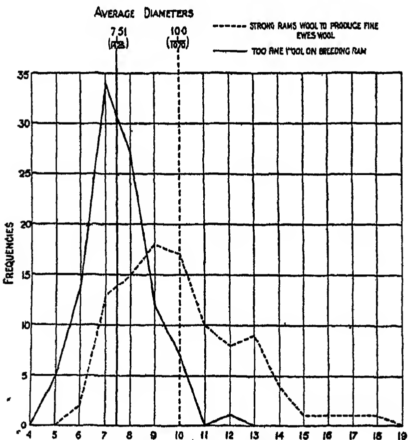

FIG 3—Micro-measurements.

versa are broadly consistent in their "quality" estimations,

4 Wool-classers in Australia as against wool-sorters in Bradford show small differences in their "quality" estimations—not always unimportant—when contrasted with one another,

5 Varying trade standards and varying conditions of the wools being classed or sorted affect the quality estimation,

6 Micro-metrical measurements may almost always be made under similar conditions, so that such "quality" estimations should be quite consistent,

7 Owing to the impossibility of examining more than a very few of the fibres under estimation (100 tests each in Figs 1 and 2) the micro-metrical estimation is liable to give very erroneous results unless the test samples of fibres examined are very carefully selected and are truly representative of bulk

It would thus appear that, under normal conditions, the work of the well-trained wool-classer or wool-sorter is trustworthy and that, broadly speaking, micro-metrical sorting will not be markedly better, and, if not carefully undertaken, may be worse

An interesting case, however, arises when one wool happens to be, say, a 70's quality because the fibres are very consistently 1/1300 in in diameter, and another wool is a 70's quality because many fibres above 1/1300 in in diameter are balanced by others below even 1/1000 in Such a case as this is partially in evidence in Fig 3 Here are given the frequency curves for two wools specially selected by a noted Australian breeder as typical of a wool too fine (70's) and a wool about right (60's) for selected rams The two curves reveal an astonishing difference in the "make-up" of the respective wool staples, of which the breeder was totally unconscious and which neither wool-classer nor wool-sorter would be likely to make note It should also be noted that the narrow bases of the curves in Fig 2 as against the broad base of at least one of the qualities in Fig 1 might also tend to confuse the "classer" and the "sorter." Little has been done in such "correlating" as that treated here, but the subject is full of interest, and may prove to have most important bearings upon the selection of rams for breeding purposes both at home and in the Overseas Dominions In the Textile Industries Department of the University of Leeds extensive ranges of typical Merino and British pedigree wools are being dealt with, and it is hoped that eventually (*a*) definite standards and (*b*) accepted methods of testing may be adopted throughout the wool industry both at home and abroad

A F BARKER

The University,
Leeds

The Theory of Hearing

IN NATURE, April 22, 1922 (vol 109, p 518), I pointed out that a series of clicks from a toothed wheel speeded up or down or by the voice is heard as a rising or falling tone and not as a noise or a jumble of tones This fact contradicts the resonance theory of the mechanism of the cochlea

The theory has now received a blow in the experiments of Dr Harvey Fletcher at the Research Laboratories of the American Telephone and Telegraph Company and the Western Electric Company in New York (*Phys Rev*, 1924, xxiii, No 3) The fundamental and a large number of harmonics can be eliminated from a compound tone without changing the pitch of the tone A high-quality telephone system was used about which it was known that the sound coming out of the receiver was a faithful copy of that going into the transmitter Electrical filters were introduced so that any tones could be eliminated The character of the results was judged by three persons familiar with music, who agreed in every case Typical experiments are the following

Sound	Pitch	Eliminated components	Eliminated frequencies.	Pitch change	Quality change
Voice *ah*	145	F	0 to 250	None	Inappreciable
		F+1 to 2	0 to 500	,,	Small
		F+1 to 4	0 to 750	,,	Large
		F+1 to 7	0 to 1250	,,	Very large
		F+1 to 9	0 to 1500	Uncertain	Noise
		6 to ∞	1000 to ∞	None	Small
		3 to ∞	500 to ∞	,,	Large
		F −1 to 2 −6 to ∞	0 to 500 +1000 to ∞	,,	Very large
Clarinet	259	F	0 to 500	,,	Large
		F+1 to 2	0 to 1000	,,	Very large
		F+1 to 4	0 to 1500	,,	Non-musical
		7 to ∞	2000 to ∞	,,	Large
		2 to ∞	750 to ∞	,,	Pure tone with no clarinet quality

The work of Wegel and Lane (*Phys Rev*, 1924, xxiii, No 2) and Fletcher (*Phys Rev*, 1920, xv. 513) has shown that the hearing mechanism displays a non-linear response to external forces The character of the sensation when two tones are acting together on the ear varies considerably with the relative frequency and intensity values (Wegel and Lane). According to their dynamical theory, the vibrations pass along the basilar membrane and are shunted through narrow regions of the membrane at points depending on the frequency. The dynamic theory is simply a modified resonance theory

Any resonance theory fails to explain Fletcher's experiments When, for example, the fundamental is removed from a clarinet tone, there is no change in the pitch of the tone According to the resonance theory a sensation of tone corresponds to the vibration of a region of the fibres of the basilar membrane and vice versa. Here vast regions of the fibres may or may not vibrate without altering the sensation of pitch The only change is one of quality Fletcher attempts to get around the difficulty by supposing that subjective tones—summation and difference tones—are introduced (!) mechanically in the cochlea into the stimulus that is sent to the brain For example, the presence of the tones 500 to ∞ in the clarinet experiment produces a sensation of a tone of the same fundamental pitch as 259 to ∞ with only a difference in quality, because these tones arouse the missing tones in the cochlea

This is a responsibility too heavy to be accepted on the basis of a hypothetical resonance analysis of the basilar membrane The responsibility becomes much less when the fibres of the membrane are regarded only as supporting and stiffening fibres not tuned to resonate The result then becomes identical with my deformation theory reported in NATURE, April 26, 1924 (vol 113, p. 605). According to this theory, the basilar membrane alters the linear movement of the stapes into a change of form in three dimensions Every external vibration produces a pattern deformation of the membrane This pattern is communicated to the brain. A single vibration of a clarinet tone produces a definite pattern in three directions on the basilar membrane The mental quality of the clarinet tone represents this pattern When this vibration is repeated regularly, the clarinet quality appears to be based on a tone of definite pitch Whether a tone of this pitch or of any other pitch is physically present in external vibrations or not, a fundamental will be heard as the loudest tone, the pitch of which is determined by the frequency of the repetitions

Fletcher's experiments are an illustration of what occurs constantly in song Many, perhaps most, vowels have no fundamental vibrations (NATURE, Jan 13 and 20, 1921, pp. 632 and 664) They are produced by a series of isolated puffs which set the vocal cavities in vibration Such vowels consist solely of higher tones than the one that is sung. Yet, although the fundamental is lacking physically, it is heard as *the* tone of the voice. The physically non-existent tone is exactly the one—and the only one—indicated by the music It is the tone intended to be sung, and is the one heard as a tone; the other tones—in this case all the tones that exist physically—are heard only as timbre or quality.

The work of Willis, Hermann, and myself on the vowels is now supplemented by the work at the New York laboratory All of it flatly contradicts the resonance theory The simple facts of the accelerated toothed wheel and of portamento speech, however, ought to have been enough to convince any one

E W SCRIPTURE.

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The Ages and Masses of the Stars.

THE very interesting correspondence between Mr Schumann and Dr. Jeans in NATURE of January 24 has not touched on one of the most difficult questions, raised by the brilliant paper in which Dr Jeans makes out such a strong case for extending our time-scale for the life of a star to some 10^{13} to 10^{14} years The problem is simply how we are to account for the existence of uranium and thorium

As is well known, uranium has a half-life period of 6×10^{9} years Therefore, even if the whole sun had consisted initially of uranium, there would barely be 2 kilograms left after 6×10^{11} years A great deal more than this exists on the earth alone. Hence, either the life of the sun and earth must be much less than 6×10^{11} years or we must make the *ad hoc* assumption that uranium is being formed or at any rate prevented from disintegrating The temperature and pressure inside the sun are much too low to affect a reaction, the energy of which is so great as the energy of formation of radioactive substances.

A solution may be found if one admits the coalescence and annihilation of protons and electrons, for then, of course, radiation with quanta of energy 1 66 $\times 10^{-3}$ would be available That this might photosynthesise uranium nuclei, though of course possible from purely energy considerations, scarcely seems plausible when one remembers that these complicated structures contain 238 protons and 146 electrons But it is not impossible that it might cause α-particles, which are presumably common in the interior of stars, to combine with lead and the heavier radioactive elements On such a theory presumably the non-radioactive substances would be assumed to be built up in the same way

The basis of this explanation, however, the seductive hypothesis that protons and electrons may coalesce and be annihilated, is not without difficulties of its own The process in question presumably would occur when a proton and electron meet under certain peculiar conditions The frequency of such encounters must almost certainly depend upon the density and, to a less extent, on the temperature. The position would be much clarified if it could be shown from astronomical evidence that the evolution of energy per unit mass varied in the appropriate way with the density and temperature.

These or similar speculations, which become inevitable if one accepts the extended time-scale, had therefore perhaps best be postponed until Dr. Jeans's theory has been further tested. They would be avoided, of course, if it could be shown that the loss of ordinary atomic mass under the influence of radiation pressure is much greater than the radiative mass emitted It is difficult to make any convincing

estimate, but should it prove to be so it would immediately reduce our time-scale and relieve us of the necessity of entering upon speculations such as those touched on above

F A LINDEMANN

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January 30

On the Hardness of Manganese Steel.

NOTWITHSTANDING its extraordinary importance, the discovery of the 13 per cent manganese steel, made by Sir Robert Hadfield more than forty years ago, has scarcely been elucidated regarding its most striking point, namely, the extremely high resistance to wear and tear, or the fact that the non-magnetic manganese steel, while comparatively soft in itself, offers an enormous resistance to a working tool

It is natural to assume that this resistance is to be explained in the following way.[1] The state of the iron in the manganese steel being that of the non-ferromagnetic γ-iron, stable at high temperature but unstable at ordinary temperatures, a mechanical stress is likely to cause the transformation into the ferromagnetic α-state, stable at low temperature This is in conformity with a general law of physical chemistry, exemplified by the well-known case of mercury iodide: the yellow modification, persisting at ordinary temperature in an unstable condition, is transformed by mechanical stress into the red modification, stable at low temperature In other words the high resistance is explained by the assumption that mechanical work transforms the relatively soft Mn- austenite (γ-Fe) into martensite (α-Fe), known to be extremely hard From this view, if correct, it follows that mechanical work will at least partly transform the non-magnetic manganese steel into the ferromagnetic α-condition

Some time ago the correctness of this conclusion was tested at this Institute by Dr A Westgren on a specimen, sent by Sir Robert Hadfield, of manganese steel which had been subjected to a tensile test

On X-ray analysis, however, no lines characteristic for α-Fe could be detected even in the contracted part of the specimen In view of this negative result, the following experiment, lately performed, seems to be of interest

A small steel magnet needle (about $3 \times 0\ 5 \times 0{\cdot}1$ mm) was fastened to one end of a thin silica fibre, so as to be suspended in a vertical position. On approaching the sharp corner, or edge, of a Hadfield manganese (Era) steel specimen, it was not possible to obtain any sensible attraction of the needle—in conformity with its non-ferromagnetic character On the other hand, a small drilling of the same steel (say $1{\cdot}2 \times 0{\cdot}4 \times 0{\cdot}1$ mm) fixed at the end of a glass capillary, when brought near the needle, revealed a considerable attraction, or repulsion, proving the *drilling to be plainly ferromagnetic*, and this even permanently The objection being possible that the ferromagnetism might be caused by steel particles given off by the drill used, metallic shavings were obtained by using sharp quartz edges, and also a slow rotating alundum disc, in both cases the shavings were found to be distinctly ferromagnetic

Since it had been established in this way that the shavings have the magnetic characteristics of martensite, they were submitted to X-ray analysis by Dr. Westgren However, no lines of the α-state could be detected The reason probably lies in the fact that the α-lines are sharp only for a comparatively pure α-iron lattice, and rather blurred for the α-solid solutions, if in addition the α-portions occurring are few in number and very small, the analysis method developed as yet, is not sensitive enough to detect them It may be considered as established that the difficulty in working non-magnetic manganese steel, is due, at least partly, to its partial transformation into martensite

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[1] C Benedicks, "Hadfield's undersökningar över specialstål," *Teknisk Tidskrift*, Bergsvet, 1923, p 25

A Stroboscopic Method of Determining Surface Tension of Liquids.

OF the various methods of determining surface tension of liquids, the method of ripples is free from all surface influences Lord Rayleigh, Dorsey, Grunmach, Kalahne and others have determined the surface tension of water by this method Grunmach applied the same method in determining the surface tension of some of the molten metals, but the main difficulty was that of observing the ripples properly to measure the wave lengths exactly, and the accurate estimation of the vibration frequency of the exciting fork Unless the stroboscopic arrangement is perfect, there is always an uncertainty in the determination

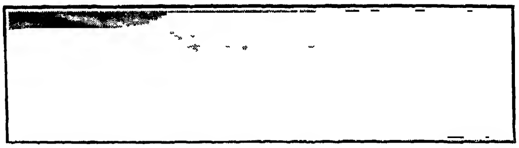

FIG 1

of λ accurately, and as λ^3 is to be taken in the calculation, a slight variation in the value of λ affects the final value

We have, however, devised a method by which the stroboscopic arrangement is completely satisfactory By fixing a fine edge to the prong of the exciting fork, and observing the reflection of this edge on the surface of the liquid at Brewster's angle (for water it is 53° 6′) fine teeth appear on the reflected image of the fine edge These teeth remain absolutely stationary so long as the vibrations of the fork remain constant The tips of the teeth are extremely sharp and stand a good deal of magnification (Fig. 1) The measurements of λ, therefore, could be made accurately The excitation is produced by a fine needle soldered to one end of this edge, the needle dipping only about 0 25 mm below the liquid surface The ripples are scarcely visible on the surface

The result given by this simple apparatus is satisfactory, namely, 74 1 in the case of clean distilled water The vibrations of the tuning-fork are also recorded along with a standardised seconds pendulum, so that the frequency can be ascertained with great accuracy up to the second place of decimals A slight touch of grease at once increases λ considerably, as has been pointed out by Lord Rayleigh.

P. N GHOSH.
D BANERJI.

University College of Science,
Calcutta,
December 24.

The Permanence of Substance.

By Sir JOSEPH LARMOR, F R S

IN Victorian times the atoms of matter were described by Clerk Maxwell, in picturesque and weighty phrase, as the "foundation stones of the material universe" It was believed that an æthereal medium for physical intercommunication in the cosmos was essential and if so, material systems could not arise as other than mobile structures inhering in that universal medium The standard illustration (for that was its true function) which went far by visual experiment to give vitality as well as precision to this general doctrine, was the Kelvin formulation of vortex atoms, based on Helmholtz's advances in the exact hydrodynamics of ideal perfect fluid, and lying in the natural succession to the brilliant but often fantastic gropings after vortical imagery by Descartes The force of the illustration lay in the certainty that in the ideal pervading medium such vortex structures could not be wiped out, must be indestructible for ever The ultimate atoms of matter, which stimulated the investigation of these vortical ring structures by way of analogy, have now been pushed back, first in theory and afterwards far more precisely by experimental discovery, to the electronic constituents of the chemical atoms

If there is an æther, matter must be of necessity atomic, the possible variety of atoms being restricted to the limited number of types of suitable structure that are dynamically stable: and conversely, if matter is found to consist actually of self-contained atomic structures, this central fact is either evidence for a universal æther in which all matter subsists, or else must remain wholly inexplicable, perhaps even inscrutable Such would be the modern version of the great argument of Democritus, on atoms and the void.

On the other hand, in extreme modern developments of the idea of relativity, the material universe seems to have no "foundation stones" An ultimate atom of matter is not there describable as an essential structure at all, such as can be explored, of course only partially, yet to an increasing degree which becomes adequate for more and more scientific purposes It usually appears as nothing but a local aggregation of electric charge, held together by unknown internal constraint which is assumed not to disturb other relations It can thus be liable to dissolve itself into pure motional energy by fusion with opposite charges; and the fact that the measures of mass and energy are modified in the same way by change of the frame of reference lends plausibility The end of the cosmos would be the vanishing of matter its beginnings must be on every scheme inscrutable

It seems to be mainly with a view to elegance and completeness in the algebra that the electronic nucleus is thus introduced merely as a local aggregation of electric charge with some permanent law of volume-density At a later stage it became recognised that internal forces are needed to hold it together; and whatever they may be they must not interfere with its necessary relativity as a whole as regards uniform translatory motion They seem to be disposed of by being classed in the exposition as an unknown part of the stress-tensor of the field Thus this procedure can be in no respect an improvement on the classical method which it claims to supersede, of regarding an electron as a structural singularity unknown except so far as it is defined by increasing knowledge of the field that is physically attached to it by its very constitution Even in pure spatial analysis of differential geometry a singular pole is approached through the influence it sheds around the algebra never gets into the inside of it, so to say That is the classical way, and can be held to be the correct scientific method, of approach to the properties of the unknown permanent electron or atom The occasional denial of it seems possibly to be linked up with a metaphysical doctrine[1] that all natural law is nothing more than a manifestation of the *quasi*-geometric qualities of a fourway continuum named space-time, so that a complete exploration throughout it, by continuous spatial analysis without inherent unexplored poles, must be the aim of physical theory The alternative view is that the infinitely little transcends human grasp by involving just as great inherent complexity as does the infinitely large, though both can be approached and annexed, with increasing completeness, to our scientific schemes, by virtue of transcendental relations of mind to matter which lie at the root of all possibility of knowledge or scientific formulations

In further illustration of the contrast of methods, these hypothetical internal stress-forms the rôle of which is to hold a local distribution of electric density together, and so constitute an electron, may be more closely considered They are now often referred to as the "forces of Poincaré," because he found out that for a shell model of the electron they can be formulated simply as an isotropic pressure, and without doing any violence to the relativity postulate for the structure. But, on the illustrative analogy of a rotational æther, it had been familiar that, for any static model, all that was required was to bring into play in the theory just this hydrostatic pressure that obviously can subsist in such an æther Yet, viewed from this more concrete or physical point of view, that was not sufficient; for it was immediately recognisable that such a shell model is an unstable structure, much as is actually an electrified soap-bubble, thus requiring that analogies along that line had to remain in abeyance pending possible formulation of plausible slight constraints such as might protect the illustrative structure from destruction But without assuming any definite internal structure for the electron at all—all such models are suggestive and valuable for consolidation of knowledge, none can be complete or final—we can postulate merely that it is permanent and is mobile, and explore, by mixed observation and theory, the nature of the field around it with continually increasing precision, and also the mutual influences of neighbouring electrons which arise from the superposition of their fields This tentative procedure runs parallel to the course of actual progress · while any postulate of reduction of physical science to a self-contained

[1] An alternative form of the postulate, that nothing may be the subject of reasoning that cannot be observed, seems to imply a sense of humour

geometric analysis in space-time may savour of reproducing the infinite with finite appliances

It was already implicit in the Maxwellian æther-theory of half a century ago that a loss of energy δE from a material system, if it occurs by radiation, involves proportionate loss of inertial mass, of amount $\delta E/c^2$, where c is the speed of radiation and vice versa Such loss would have to fall on the internal relative potential and kinetic energies of the constituents of the radiating atom There appears to be some astronomical knowledge now available, following on the lines of an idea recently introduced and explored by Dr. Jeans (Monthly Notices R A S, November 1924, just now to hand), to estimate extreme superior limits restricting the amount and duration of radiation from the sun or a star that could be conceivable from this source of supply This new type of limit, doubtless, however, quite unapproachable, and uncertain as depending on an estimate of the internal mutual energies of the atom that may be available for running away into radiation, would stand in contrast, for example, with the famous historical estimate, enormously smaller, afforded by the running down into radiation of energy located outside the atoms, that of the mutual gravitation of the parts of the system in bulk; which was put forward in the early days of the conservation of energy by Kelvin and independently in more searching and complete manner by Helmholtz to explain the solar heat, but is now regarded on cogent grounds as inadequate for the facts of cosmic evolution when taken by itself

Data are perhaps not entirely wanting for an estimate of the kind here described, along two ways of approach. The total energy of relative positions and motions of electrons and other ultimate nuclei in the atom, such as might by the hypothesis possibly escape into energy of radiation, can on the lines of present general ideas of atomic structure be roughly set out Indeed, the maximum possible transfer into radiant energy for all time would be measured by the total mutual energy of the initially disgregated elements, electrons and nuclei, that first fall into chemical atoms, of orbital type, and then ultimately on their destruction lapse together into closest contact It is conceded that if atomic nuclei are regarded as finite electric charges concentrated almost into mere points, thus involving practically infinite space-density and so allowing the charges to approach infinitely near, this amount of possible radiation could tend to increase beyond measure. But that would introduce infinities in all directions, for example, infinite inertia of an atom, and is perhaps not contemplated on any kind of theory (As the complete transformation, vice versa, of the gases from 1 c c of radium releases heat to the order of 10^7 calories, an easy computation shows that the preponderant nuclear energies of the atoms must there be very deeply drawn upon, as, of course, is now familiar, though not so much as to involve recognisable diminution of mass. Cf Rutherford and his coadjutors, as reported in his treatise.)

There seems to be another corroborating mode of approach, which must indeed be obvious, one which also affords some confirmation of our postulate of indestructibility of the primordial atoms It lies in the cardinal discovery of Aston that the standard relative atomic masses of all the chemical elements are expressible in high approximation by integers, with only one challenging exception. When in the cosmic process two atoms are imagined to combine, forming an atom of a more complex kind of matter, there would thus be no room for much conversion of mass into energy: the mutual energy, residing in the local fields, that can become free to run away into radiation, must correspond to the equivalent of a very small portion, perhaps on the experimental results not more than one-tenth per cent, of the total mass, however intimate be the consolidation that is required into one central nucleus for the new atom

For astronomical purposes Dr. Jeans has made an estimate of the course of evolution for the universe, if all the matter in it were classed as a form of energy convertible into radiation He finds, on Eddington's hypotheses, that durations of the present cosmic order ranging around two hundred millions of millions of years would become conceivable Perhaps if only the mutual positional and motional energies of the ultimate discrete constituents of atoms could at the very most run into radiation, the energy thus assumed to be available (which is no measure of the duration of the system) must be reduced on the first estimate above by a factor which might be as small as 10^{-8} or as great as 10^{-5}, and on the other by a factor which could not exceed 10^{-3}

Apart from such interesting change in formulation of an ultimate cosmic problem, the object of the present discussion is to concentrate on one fundamental question, which has become conspicuous in much recent ultra-physical speculation Is matter to be regarded as consisting irrevocably of primordial atomic structures absolutely permanent or alternatively, discarding all structural analogies based on classical dynamical principles, are the atoms, if such then really are retained, to be considered as mere concretions or aggregations liable to dissipate entirely into energy of radiation and so vanish ?

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R.S.

7 OSBORNE REYNOLDS (1842–1912).

WHENEVER I hear of a man who is described as being lovable, the figure of Osborne Reynolds rises up before me; and yet I doubt whether on a casual acquaintance or in official intercourse that adjective would have suggested itself. In ordinary conversation he often took a cynical view of things; he was obstinate in adhering to his own opinion, absolutely uncompromising, and sometimes a little hasty in imputing selfish motives to his opponents. But the discordant elements of his character were fused together by an almost primitive simplicity of mind, and after closer acquaintance few could resist the charm of his strong personality

His loyalty to friends and colleagues knew no bounds.

[1] Continued from p 199

In 1883, Mr E. J Stone, formerly Astronomer Royal at the Cape of Good Hope and—at the time—president of the Royal Astronomical Society, made a series of communications to the Society in which he claimed to show that the discrepancies between the lunar tables and the observed position of the moon had no reality, but were only natural consequences of the changes which had, from time to time, been introduced in the adopted mean solar day, and in particular, that the errors of Hansen's tables of the moon were due to the adoption of Leverrier's solar tables by the British Nautical Almanac The matter was of the highest importance, as it affected our fundamental unit of time The subject is intricate and full of pitfalls, but clear-headed men like Adams, Cayley, and Newcomb all came to the conclusion that Stone's assertion could not be maintained I must have mentioned the matter to Osborne Reynolds He had no special interest in astronomy, in fact, he knew very little about it, but he had been a fellow of Queen's College, Cambridge So had Stone, and that was sufficient reason why Stone should be right When I quoted Cayley and Adams it made no impression Reynolds maintained the general thesis that when a man of established reputation has the whole scientific world against him, it is quite certain that the man who stands alone is right. After considering the subject for a few days he came to me and said "I have gone into the question, and I remain convinced that Stone is right" Again two days later he expressed the same opinion Another week passed and he recanted, admitting that Stone was wrong But he had spent more than a week on a new, and probably uncongenial, subject in the forlorn hope of being able to support a friend

An interesting chapter in the history of science could be written on the hampering effect of knowledge that is either deficient or too complete. Ignorance may lead astray, but perfect knowledge often acts as a brake and stops the car when a reckless spurt would take the driver into new territory. For the moment I am thinking of the early history of the radiometer, though this is not perhaps the best example that could be chosen The manner in which Crookes was led from certain irregularities of weighing to the construction of his interesting little instrument was wholly admirable, and some of the steps in the research, such as the improvement of air-pumps, marked considerable advances, while other incidental results are of permanent value But it is permissible to ask whether any one wholly conversant with the property of gases at low pressures, and therefore able to anticipate the effect discovered by Crookes, would have taken all the trouble to spend two years in demonstrating it. Even if familiar with Maxwell's radiation pressure, perfect knowledge would have recognised that there was no immediate hope of verifying it experimentally until the methods of obtaining high vacua were improved to a degree not dreamt of in those days

There can be no doubt that the driving power of Crookes's work was the hope of discovering a new property of radiation The first communication read before the Royal Society in December 1873 concludes with the following statement "In the radiant molecular energy of cosmical masses may at last be found that 'agent acting constantly according to certain laws,' which Newton held to be the cause of gravity." He modified his views later, and ascribed the effect to light "even where there is no heat" (NATURE, Vol. 12, p 124)

Reynolds recognised that the apparent repulsion could be explained without the help of unknown forces in the belief, at first, that they were due to condensed moisture evaporating under the influence of thermal radiation, but he soon replaced this view by the now generally accepted theory Johnstone Stoney had put forward similar ideas which, nevertheless, differed in essential points

During the winter of 1873–74 I suggested to Reynolds, as I had done to others, that the main question whether the repulsion was caused by internal or external forces could be solved in a very simple manner, by the reaction on the containing vessel When I returned in November 1875 from the Siamese eclipse, I found controversies still raging, but no one had taken the trouble to try the crucial experiment I was reluctant to do so myself, as a number of persons were working on the subject, and I have perhaps an exaggerated objection to cutting into what I consider to be other people's work. I repeatedly spoke to Reynolds about it in the hope that he would take the matter up One evening after lecturing hours, while I was working alone in the Physical Laboratory, Osborne Reynolds entered the room and said: "I want you to do that experiment you spoke of, and to do it now. I have got everything ready for you" I went with him to the lecture room We suspended the radiometer with an attached mirror, and, at the first trial, it behaved as it should. The vessel swung round as soon as the light fell on the blackened surfaces, and returned to its position of rest when the rotation of the vanes had reached the steady state. Reynolds would not listen to the proposal of a joint communication, and my paper appeared in due course in the Philosophical Transactions

In his writings, as in his speech, Reynolds was difficult to understand His brain seemed to work along lines different from those of the majority of us He looked upon all things in an original manner, and the education of his children was one of them I once found him playing with his little son, and nothing seemed to give him greater pleasure than when the boy did the opposite thing to that which he was asked to do "Come here," said Reynolds, and when the child went further away Reynolds was delighted, interpreting the act as showing independence of spirit. The incident made a great impression on me

In his later years Reynolds had difficulty in finding the right word, using sometimes one that had the opposite meaning to that required This failing ultimately developed into a regular aphasia

The value of his scientific work is admirably described in the obituary notice published by the Royal Society. It may be added that though his theory of the construction of the universe, on which he concentrated his whole strength at the end of his scientific life, received little support, it may yet find its place in reconciling the old and new physics

In his lectures Reynolds was often carried away by his subject and got into difficulties Some humorous incidents are related with regard to the manner in which he got out of them. He was once explaining the slide

rule to his class, holding one in his hand, he expounded in detail the steps necessary to perform a multiplication "We take as a simple example three times four," he said, and after appropriate explanations he continued, "Now we arrive at the result; three times four is 11 8." The class smiled "That is near enough for our purpose," said Reynolds It may be imagined that the average student was often puzzled; but nevertheless, the number of scientific engineers of high standing that he trained is a testimony to his teaching power, when he had the right material with which to deal That power was not one of imparting knowledge but rather of stimulating thought

Not long ago a representative of the University of Manchester lectured in the United States. At the conclusion of the lecture a gentleman stepped out from the audience, and addressing the lecturer, said. "I understand that you come from Manchester. I owe all my success in life to Osborne Reynolds, and I ask you to accept a cheque for the benefit of the University as a sign of gratitude" No one could wish for a higher testimonial than that.

The Fossil Anthropoid Ape from Taungs.

By Sir Arthur Keith, F.R S

The discovery of fossil remains of a "man ape" in South Africa raises many points of great interest for those who are studying the evolution of man and of man-like apes No doubt when Prof Dart publishes his full monograph of his discovery, he will settle many points which are now left open, but from the facts he has given us, and particularly from the accurate drawing of the endocranial cast and skull in profile, it is even now possible for an onlooker to assess the importance of his discovery I found it easy to enlarge the profile drawing just mentioned to natural size and to compare it with corresponding drawings of the skulls of children and of young apes When this is done, the peculiarities of Australopithecus become very manifest

Prof. Dart regrets he has not access to literature which gives the data for gauging the age of young anthropoids In the specimen he has discovered and described, the first permanent molar teeth are coming into use Data which I collected 25 years ago show that these teeth reach this stage near the end of the 4th year, two years earlier than is the rule in man and two years later than is the rule in the higher monkeys In evolution towards a human form there is a tendency to prolong the periods of growth Man and the gorilla have approximately the same size of brain at birth, the rapid growth of man's brain continues to the end of the 4th year, in the gorilla rapid growth ceases soon after birth

Prof. Dart recognises the many points of similarity which link Australopithecus to the great anthropoid apes—particularly to the chimpanzee and gorilla. Those who are familiar with the facial characters of the immature gorilla and of the chimpanzee will recognise a blend of the two in the face of Australopithecus, and yet in certain points it differs from both, particularly in the small size of its jaws

In size of brain this new form is not human but anthropoid In the 4th year a child has reached 81 per cent of the total size of its brain, at the same period a young gorilla has obtained 85 per cent of its full size, a chimpanzee 87 per cent From Prof Dart's accurate diagrams one estimates the brain length to have been 118 mm—a dimension common in the brains of adult and also juvenile gorillas The height of the brain above the ear-holes also corresponds in both Australopithecus and the gorilla—about 70 mm But in width, as Prof. Dart has noted, the gorilla greatly exceeds the new anthropoid; in the gorilla the width of brain is usually about 100 mm., in Australopithecus the width is estimated at 84 mm. The average volume of the interior of gorillas' skulls (males and females) is 470 c c, but occasional individuals run up to 620 c c. One may safely infer that the volume of the brain in the juvenile Australopithecus described by Prof. Dart must be less than 450 c c, and if we allow a 15 per cent. increase for the remaining stages of growth, the size of the adult brain will not exceed 520 c.c. At the utmost the volume of brain in this new anthropoid falls short of the gorilla maximum Even if it be admitted, however, that Australopithecus is an anthropoid ape, it is a very remarkable one It is a true long-headed or dolichocephalic anthropoid—the first so far known In all living anthropoids the width of the brain is 82 per cent or more of its length, they are round-brained or brachycephalic; but in Australopithecus the width is only 71 per cent of the length Here, then, we find amongst anthropoid apes, as among human races, a tendency to roundness of brain in some and to length in others. On this remarkable quality of Australopithecus Prof. Dart has laid due emphasis

This side-to-side compression of the head taken in conjunction with the small size of jaws throw a side light on the essential features of Australopithecus. The jaws are considerably smaller than those of a chimpanzee of a corresponding age, and much smaller than those of a young gorilla There is a tendency to preserve infantile characters, a tendency which has had much to do with the shaping of man from an anthropoid stage. The relatively high vault of the skull of Australopithecus and its narrow base may also be interpreted as infantile characters It is not clearly enough recognised that the anthropoid and human skulls undergo remarkable growth changes leading to a great widening of the base and a lowering or flattening of the roof of the skull In Australopithecus there is a tendency to preserve the fœtal form

When Prof Dart produces his evidence in full he may convert those who, like myself, doubt the advisability of creating a new family for the reception of this new form It may be that Australopithecus does turn out to be "intermediate between living anthropoids and man," but on the evidence now produced one is inclined to place Australopithecus in the same group or sub-family as the chimpanzee and gorilla. It is an allied genus It seems to be near akin to both, differing from them in shape of head and brain and in a tendency to the retention of infantile characters. The geological evidence will help to settle its relation-

ships One must suppose we are dealing with fossil remains which have become embedded in the stalagmite of a filled-up cave or fissure of the limestone cliff.

May I, in conclusion, thank Prof Dart for his full and clear description, and particularly for his accurate drawings. One wishes that discoverers of such precious relics would follow his example, and, in place of reproducing crude tracings and photographs, give the same kind of drawings as an engineer or an architect prepares when describing a new engine or a new building

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By Prof G ELLIOT SMITH, F R S

IT is a great tribute to Prof Dart's energy and insight to have discovered the only fossilised anthropoid ape so far obtained from Africa, excepting only the jaw of the diminutive Oligocene Propliopithecus from the Egyptian Fayum Whether or not the interpretation of the wider significance he has claimed for the fossil should be corroborated in the light of further information and investigation, the fact remains that his discovery is of peculiar interest and importance

The simian infant discovered by him is an unmistakable anthropoid ape that seems to be much on the same grade of development as the gorilla and the chimpanzee without being identical with either So far Prof Dart does not seem to have "developed" the specimen far enough to expose the crowns of the teeth and so obtain the kind of evidence which in the past has provided most of our information for the identification of the extinct anthropoids Until this has been done and critical comparisons have been made with the remains of Dryopithecus and Sivapithecus, the two extinct anthropoids that approach nearest to the line of man's ancestry, it would be rash to push the claim in support of the South African anthropoid's nearer kinship with man Prof Dart is probably justified in creating a new species and even a new genus for his interesting fossil: for if such wide divergences between the newly discovered anthropoid and the living African anthropoids are recognisable in an infant, probably not more than four years of age, the differences in the adults would surely be of a magnitude to warrant the institution of a generic distinction

Many of the features cited by Prof Dart as evidence of human affinities, especially the features of the jaw and teeth mentioned by him, are not unknown in the young of the giant anthropoids and even in the adult gibbon

The most interesting, and perhaps significant, distinctive features are presented by the natural endocranial cast They may possibly justify the claim that Australopithecus has really advanced a stage further in the direction of the human status than any other ape. But until Prof Dart provides us with fuller information and full-size photographs revealing the details of the object, one is not justified in drawing any final conclusions as to the significance of the evidence

The size of the brain affords very definite evidence that the fossil is an anthropoid on much the same plane as the gorilla and the chimpanzee But while its brain is not so large as the big gorilla-cast used for comparison by Prof Dart, it is obvious that it is bigger than a chimpanzee's brain and probably well above the average for the gorilla But the fossil is an imperfectly developed child, whose brain would probably have increased in volume to the extent of a fifth had it attained the adult status Hence it is probable the brain would have exceeded in bulk the biggest recorded cranial capacity for an anthropoid ape, about 650 c c. As the most ancient and primitive human brain case, that of Pithecanthropus, is at least 900 c.c in capacity, one might regard even a small advance on 650 c c as a definite approach to the human status The most suggestive feature (in Prof Dart's Fig 5, p 197) is the position of the sulcus lunatus and the extent of the parietal expansion that has pushed asunder the lunate and parallel sulci—a very characteristic human feature.

When fuller information regarding the brain is forthcoming—and no one is more competent than Prof Dart to observe the evidence and interpret it—I for one shall be quite prepared to admit that an ape has been found the brain of which points the way to the emergence of the distinctive brain and mind of mankind Africa will then have purveyed one more surprise—but only a real surprise to those who do not know their Charles Darwin But what above all we want Prof Dart to tell us is the geological evidence of age, the exact conditions under which the fossil was found, and the exact form of the teeth.

By Sir ARTHUR SMITH WOODWARD, F R S

THE new fossil from Taungs is of special interest as being the first-discovered skull of an extinct anthropoid ape, and Prof Dart is to be congratulated on his lucid and suggestive preliminary description of the specimen. As usual, however, there are serious defects in the material for discussion, and before the published first impressions can be confirmed, more examples of the same skull are needed

First, as Prof Dart remarks, the fossil belongs to an immature individual with the milk-dentition, and, so far as can be judged from the photograph, I see nothing in the orbits, nasal bones, and canine teeth definitely nearer to the human condition than the corresponding parts of the skull of a modern young chimpanzee The face seems to be relatively short, but the lower jaw of the Miocene Dryopithecus has already shown that this must have been one of the characters of the ancestral apes The symphysis of the lower jaw may owe its shape and the absence of the "simian shelf" merely to immaturity; but it may be noted that a nearly similar symphysis has been described in an adult Dryopithecus, of which it may also be said that "the anterior symphyseal surface is scarcely less vertical than that of Heidelberg man" (see diagrams in Quart Journ Geol. Soc, vol 70, 1914, pp 317, 319)

Secondly, the Taungs skull lacks the bones of the brain-case, so that the amount and direction of distortion of the specimen cannot be determined. I should therefore hesitate to attach much importance to rounding or flattening of any part of the brain-cast, and would even doubt whether the relative dimensions of the cast of the cerebellum can be relied on. Confirmatory evidence is needed of the reality of appearances in such a fossil

In the absence of knowledge of the skulls of the fossil anthropoid apes represented by teeth and fragmentary jaws in the Tertiary formations of India, it is premature to express any opinion as to whether the direct

ancestors of man are to be sought in Asia or in Africa The new fossil from South Africa certainly has little bearing on the question

Palæontologists will await with interest Prof Dart's detailed account of the new anthropoid, but cannot fail to regret that he has chosen for it so barbarous (Latin-Greek) a name as Australopithecus.

By Dr W. L. H DUCKWORTH.

PROF DART'S description of the fossil skull found at Taungs in Bechuanaland shows that this specimen possesses exceptional interest and importance Should the claims made on its behalf prove good, then its discovery will in effect be comparable to those of the Pithecanthropus remains, of the Mauer mandible and the Piltdown fragments In the following paragraphs I venture to make some comments based upon perusal of the article published in NATURE of February 7

First of all, the fact that the fragments came immediately under notice of so competent an anatomist as Prof Dart establishes confidence in the thoroughness of the scrutiny to which they have been subjected. That the history of the specimen should be known precisely from the time of its release from the limestone matrix, provides another cause for satisfaction

The specimen itself at once raises a number of questions, and, as Prof Dart evidently realises, these fall into at least two categories The first question arising out of the discovery is the status of the individual represented by these remains But the answer to that question, and the presence of such a creature in South Africa, affect other problems. The latter include inquiry into the probable locality of origin of the simian and human types, and the search for evidence of dispersion from a centre, or along a line of successive migrations

In dealing with the first problem, Prof. Dart has surveyed a considerable number of structural details, and he concludes that the specimen represents an extinct race of apes intermediate between living anthropoid apes and mankind The specimen comprises the greater part of a skull with the lower jaw still in place (or nearly so) The number and characters of the teeth testify to the immaturity of the individual. The evidence on the last-mentioned point is quite definite, and interest thus comes to be centred in the status assigned to the specimen; namely, that of a form intermediate between the living anthropoid apes and man himself

Prof Dart places the specimen on the side of the living anthropoid apes in relation to the interval separating these from man. At the same time, it is claimed that this new form of ape is more man-like than any of the existing varieties of anthropoid apes, and so it comes about that the decision turns on the claims made for the superiority of the new ape to these other forms

The report shows that (as noted above) many structural details have been scrutinised, and that all accessible parts of the specimen have been examined The observations relate not only to the external parts of the skull and lower jaw, but also to the endocranial parts exposed to view by the partial shattering of the brain-case. The claims advanced on behalf of the higher status of the specimen are based, therefore, upon a number and variety of such details Should Prof Dart succeed in justifying these claims, the status he proposes for the new ape-form should be conceded. Much will depend on the interpretation of the features exhibited by the surface of the brain, as also upon that of all the characters connected therewith, and since Prof Dart is so well equipped for that aspect of the inquiry, his conclusions must needs carry special weight there In regard to the brain and its characters, I find the tracing of the contour of an endocranial cast in a gorilla-skull shown in Fig 6 rather surprisingly flattened, and almost suggestive of the influence of age

Among the anatomical characters enumerated in the article, some appear to me to possess a higher value in evidence than others As good points in favour of the claims, there may be cited, in addition to the cerebral features to which reference has just been made, the level of the lower border of the nasal bones in relation to the lower orbital margins, the (small) length of the nasal bones, the lack of brow-ridges (even though the first permanent tooth has appeared fully), the steeply-rising forehead, and the relatively short canine teeth

On the other hand, I feel fairly certain that some of the other characters mentioned are related preponderantly to the youthfulness of the specimen Fully to appreciate the latter, demands not only the handling of it, but also thorough survey of a collection of immature (anthropoid ape) crania The development of the "shelf" at the back of the symphysis of the lower jaw may almost certainly be delayed in some individuals (gorillas) Even the level of the lower border of the nasal bones is subject to some variation, and in young gorillas before the first permanent tooth has emerged fully, that level may be (as in man) above the level of the orbital margin Generally, the elimination and detachment of features influenced largely by the factor of age demand special attention.

If, however, the good points can be justified, then these characters of youth will not gravely affect the final decision

However these discussions may end, the record remains of the occurrence of an anthropoid ape some two thousand miles to the south of the nearest region providing a record of their presence So far as the illustrations allow one to judge, the new form resembles the gorilla rather than the chimpanzee, that is, an African, not an Asiatic form of anthropoid ape. In this respect the new ape does not introduce an obviously disturbing factor Disturbance, and the re-casting of disturbed views, might nevertheless be caused in two other directions Thus, the determination of the geological antiquity of the embedding of the fossil remains might have such an effect, were the estimate such as to carry that event very far back in time. Again, a comparison of the new ape with the fossil forms from India (Siwaliks) remains to be made, and it may be productive of results bearing on the relation of the African and the Asiatic groups In any case, opinion must needs conform to the situation created by this discovery.

If in these notes there have been passed over those observations and reflections wherewith Prof Dart has illustrated and supported his views, such omissions are not due to want of appreciation, but to lack of capacity and space for their adequate treatment.

Obituary.

MR OLIVER HEAVISIDE, F R S

BY the death of Oliver Heaviside the scientific world loses one of its most original thinkers He was born in London on May 13, 1850, and his uncle was Sir Charles Wheatstone, the practical founder of modern telegraphy The Heaviside family were interested in music and telegraphy His brother Charles, who lived at Torquay, was connected with the musical industry, and his brother, Arthur West Heaviside, was a superintending engineer to the Post Office and one of the pioneers of radio telegraphy

After leaving school Heaviside obtained a post with the Great Northern Telegraph Co. at Newcastle-on-Tyne, which he held for several years During this period he communicated papers to the *English Mechanic*, the *Telegraphic Journal* and the *Philosophical Magazine*. These papers are of more than average ability and show great promise For example, in 1873 he showed that quadruplex telegraphy was a possibility Unfortunately, in 1874, increasing deafness made him retire from business life and he went to live in Devon He now devoted himself whole-heartedly to the study of electricity and its applications He published many papers which gradually became more and more technical and more and more difficult to understand, as it became necessary, in order to avoid repetition, to assume that the reader knew some of the writer's previous work Consequently he had difficulty in getting them published in the ordinary technical journals At that period there were few referees competent to understand them As a rule they suggested that the paper should be cut down The result was that many necessary mathematical links were left out, and the expert has no easy task to follow the reasoning Fortunately, several well-known scientific men—in particular Sir Oliver Lodge, Prof Perry, and Dr G F C Searle—had noted the advent of a mathematical physicist of superior ability and helped him to get his papers published He had, however, to run the gauntlet of a good deal of unintelligent criticism, and none of his discoveries received that immediate recognition which their merit deserved

Heaviside communicated to the Society of Telegraph Engineers (now the Institution of Electrical Engineers) a paper solving the problem of the electrostatic and electromagnetic interference between overhead parallel wires, a problem which has come to the front at the present time. His methods of measuring mutual inductance published in 1887 are of great value in themselves, and, like most of Heaviside's work, have been most fruitful in suggesting extensions to others. He was the first to solve the problem of the high-frequency resistance and inductance of a concentric main It would probably have remained neglected for many years had not Kelvin given some of his results in his presidential address to the Institution of Electrical Engineers in 1889

From the practical point of view, Heaviside's most important work was laying the foundation of the modern theory of telephonic transmission; a theory which has proved a veritable gold mine for the practical telephonist He pointed out that the difficulties which arose in telephony were due to the different attenuations and different velocities of the various component waves which carry the necessary currents His theory of the distortionless circuit showed clearly the lines on which telephony could be developed Working on these lines some ten years later, Prof Michael Pupin in the United States developed his loading coils, and long-distance telephony was born.

In 1891 Heaviside was elected a fellow of the Royal Society In 1892 his earlier "Electrical Papers" were published in two volumes The value of his work began then to be realised by electricians He did perhaps more than any man to show the value of a knowledge of physics and of mathematical theory in the electrical industry Pupin has said that Heaviside did much "to introduce the living language of physics in place of the sign language of mathematical analysis" Heaviside's pioneering work will always take a leading place in the history of electrical theory

The first volume of Heaviside's great work on "Electromagnetic Theory" was published in 1893 and the second volume in 1899 His original intention was to publish the third volume in 1904 and the concluding volume in 1910, but this he found impossible, and so published the third and concluding volume in 1912.

Heaviside was the first to give the theory of the steady rectilinear motion of an electron through the ether, a theory which has been developed by others—notably by Searle—with important results By an electron he simply meant an electric charge He pointed out many years ago that even if we knew the constitution of the electron we would be a long way from finality There is no absolute scale of size in the universe As it is boundless in one way towards the great, it is equally boundless towards the small He was one of the first to predict the increase of mass of a moving charge when its speed becomes very great To verify all Heaviside's reasoning and especially to examine the validity of some of his mathematical methods will provide work for many mathematicians and physicists He strongly resented the contemptuous tone adopted by some mathematicians when referring to his work on divergent and semi-convergent series He had found them useful in general theory and for computing purposes, and so he naturally considered his critics prejudiced In June 1902 he wrote the article on the "Theory of the Electric Telegraph" in the "Encyclopædia Britannica" Many theorems given in this article are constantly quoted by the writers of text-books In particular his description of what is now called the Heaviside layer, by means of which Hertzian waves are supposed to be bent round the earth, is familiar to every radio engineer

In the later years of his life Heaviside was one whom every electrical engineer delighted to honour In 1908 he was elected an honorary member of the Institution of Electrical Engineers. When in 1921 the Faraday Medal was founded, it was universally considered most appropriate that Heaviside should be the first Faraday medallist. The president, Mr J S. Highfield, went to Torquay and presented it to him in person He was an honorary Ph D of Gottingen, an honorary member of the Literary and Philosophical Society of Manchester and of the American Academy of Arts and Sciences.

For fifty years Heaviside lived practically a hermit's life at Torquay He was a good correspondent, but very difficult to approach personally In his later years Dr. and Mrs Searle of Cambridge were practically his only friends The Government gave him a civil list pension, and about twenty years ago Mr Asquith increased it The Institution of Electrical Engineers took a filial interest in him, and it is gratifying to remember that during the last few years of his life the Institution kept in constant touch with him In the preface to his "Electrical Papers" he says that the question "Will it pay?" never interested him He was, he said, mainly actuated by philanthropic motives. Looking back—as he has probably saved the Government of every large civilised country in the world millions of pounds in the costs of their telephone schemes—he was truly a philanthropist He died at Torquay on Tuesday, February 3, and was buried on Friday, February 6, in the same grave as his father and mother, only relatives and Mr R H Tree, representing the Institution of Electrical Engineers, being present Thus ended the life of one who has left a record of work which has proved of great value to the world

A Russell.

Prof. N Kulchitsky.

The death of Prof Nicholas Kulchitsky on January 30, at the age of sixty-nine, has removed one of the foremost of Russian histologists For many years he occupied the chair of histology at the University of Charkov, where he accomplished most of his researches. His methods of fixing and staining tissues are now in universal use—those for smooth muscle are particularly well known. He devoted much attention and made numerous important observations on the distribution of connective tissue in the intestinal tract and other organs His text-books of histology are standard works and at present are commonly used by Russian medical students. That his work was well known outside his own country is shown by the fact that he was an honorary member of the Anatomical Society of Great Britain and Ireland.

Prof. Kulchitsky was a man of wide interests and sympathies. He responded whole-heartedly to the request of his government for his expert assistance in the work of the Ministry of Education, and for a number of years he held the post of administrator of education in the Charkov district and later in the Petrograd district During the period just before the first revolution he held the post of Minister of Education During the period of upheaval he suffered severely from the hardships attending revolution and counter-revolution in order to maintain his family and himself he was reduced to hard manual labour. That he was able to live through these hardships, at his advanced age, is evidence of his characteristic power for hard work and perseverance At length he was fortunate enough to embark on a British refugee ship together with remnants of Wrangel's forces, and this brought him to London, where he found shelter and opportunities for continuing his scientific endeavours.

During the brief time of less than three years, as lecturer in the Department of Histology at University College, London, Kulchitsky was largely concerned with the teaching of students, but he also completed several important and significant researches Not the least of these is that in which he showed that voluntary muscles are supplied by both medullated and sympathetic nerve fibres, the former being attached to the large muscle fibres, whilst the latter supply small muscle fibres These facts led to the physiological and clinical investigations of the late Prof. Hunter, who showed that the smaller fibres are responsible for the maintenance of tone in voluntary muscles The work has found important applications in the operation of dividing the sympathetic nerves supplying the muscles affected in cases of spastic paraplegia

Prof Kulchitsky and Prof J I Hunter were associated in their work, and it is indeed a sad coincidence that the untimely death of young Prof Hunter should so soon have been followed by the unfortunate accident, a fall down an elevator shaft at University College, which led to the death of Prof Kulchitsky

The loss of Prof Kulchitsky is deeply mourned by all his associates and friends at University College and by the scientific world in general. G V A

Dr David B. Spooner

The Archæological Department of the Indian Government has suffered a heavy loss by the death at Agra on January 30 of Dr David B Spooner, who had been Deputy Director-General of Archæology in India since 1919 and had acted on one occasion as head of the Survey during Sir John Marshall's absence on leave. Dr. Spooner's connexion with the Department commenced at the opening of the present century, and there can be no doubt that by his own efforts and achievements he did much towards giving practical effect to the policy of conservation and research inaugurated by Lord Curzon in 1902 Up to that date, official efforts to preserve the monuments of past ages and to investigate the hidden remains of antiquity were "spasmodic, desultory, unscientific and planned on a penurious scale" With the appointment of a Director-General of Archæology and a staff of able assistants, among whom Dr Spooner was deservedly considered one of the most capable, there began that enormous development of historical and archæological study which has been one of the most striking features of the twentieth century in India

Dr. Spooner did excellent work as Superintendent of the difficult Frontier Circle, but his name is more likely to be remembered in connexion with his excavations at Pataliputra, now known as Patna, the ancient capital of the Maurya dynasty of Magadha, and with the somewhat startling theory which he advanced as to the origin of the family of Chandragupta and his successors The fact that the palace of the Mauryas, discovered near the modern village of Kumrahar, was almost certainly designed in imitation of the Persian palace at Persepolis, together with other traces of Iranian influence upon the practice of the Mauryan court, led Dr. Spooner to assert that Chandragupta and his successors were of Persian origin This theory, which he published in the Journal of the Royal Asiatic Society, has been accepted by no one except, possibly, certain Parsi scholars, who were naturally gratified at the idea of a "Zoroastrian period" of Indian history But while no one disputes the fact that Persian institu-

tions were familiar to the people of northern India in the fourth and third centuries B.C., the assumption of an Iranian origin for the rulers of Magadha has no historical warranty at present, and involves the rejection of important traditional and literary evidence as to their descent.

Dr. Spooner's research work at Kumrahar needs no commendation, and he was probably led into his novel speculations about the Mauryas by his intense enthusiasm—the very quality which, combined with sedulous activity, rendered him so valuable a servant of the Government of India. *Ave atque vale.* S. M. E.

WE regret to announce the following deaths:

Sir Anderson Critchett, Bart., K.C.V.O., surgeon-oculist to the King, first president of the Council of British Ophthalmologists, president in 1894 and 1899 of the Ophthalmological Society of the United Kingdom and in 1913 of the Ophthalmic Section of the International Medical Congress held in London, on February 9, aged seventy-nine.

Dr. Horace T. Brown, F.R.S., distinguished for his work on the chemistry of carbohydrates, on the assimilation of atmospheric carbon dioxide by leaves, and on gaseous diffusion through small apertures, on February 6, aged seventy-six.

Current Topics and Events.

WIDESPREAD interest has been aroused among the general public by the publication of Prof. Dart's account of the discovery of *Australopithecus africanus*, or the Taungs Man, as the Press has elected to call him, in last week's issue of NATURE. Although the discovery dated from November last, the news had been carefully guarded, and it was only when a cable was received in England on February 4, and appeared in the Press on the following day, on the eve of the publication of the article in NATURE, that it became known. Notwithstanding the absence of precise details, the importance of the news was at once recognised by the leading London and provincial daily papers, which quoted freely from Prof. Dart's article as soon as it was available. In another part of this issue, Sir Arthur Keith, Prof. G. Elliot Smith and Dr. W. L. H. Duckworth discuss the significance of the discovery.

THE debt which the modern civilised world owes to science has seldom been acknowledged so generously, or expressed so eloquently, by responsible statesmen as by President Coolidge and by Mr. C. E. Hughes, Secretary of State, in their addresses to the recent meeting of the American Association for the Advancement of Science at Washington, D.C., which have been printed in a recent issue of *Science*. No other single agency, says the President of the United States, has relied so much upon the work of men and women of science as has his government, which has been foremost in employing and most liberal in endowing science, although it cannot claim to have been "impressively liberal" to the scientific workers whom it has employed. The scientific work done under the administrative departments has, he says, been of enormous value to the whole people. Men of science are "the wonder-workers of all the ages"; the discoveries made by them have become commonplaces because their number has paralysed the capacity of the mind for wonderment. Representatives of social and political organisations regard the march of science with awe, and sometimes with fear, when they ask themselves what will be the next revolution to which their schemes will have to be adapted; but the conviction that science works for the public weal, and that at the worst it saves life from being very monotonous, restores their confidence. It has taken endless ages to create in men the courage that will accept the truth simply because it is the truth. Comparatively few men are sufficiently gifted to be able to use the scientific method in seeking for the truth, but they no longer fear the results to which it leads. Truth is essential, and therefore all encouragement should be given to men of science and of faith.

MR. HUGHES spoke on the value of science in promoting international co-operation and concord. Science may forge new and terrible weapons of destruction, but she is far more eloquent as she points to the wastes of strife, to the retarding of progress, and to the vast opportunities which are open to those peoples who will abandon mutual fears and destroy artificial barriers to community of enterprise. Each nation should collect, collate, and safeguard all data and records made within its territory, and should make them readily available to other nations. International co-operation in research is absolutely necessary, and both national research organisations and the International Research Council are doing good work and opening up a new era of international co-operation in science. Scientific method is needed in government, in making and administering the law. The scientific attitude of mind is needed because it comprises search for pure knowledge, distrust of phrases and catchwords, hatred of shams, willingness to discard outworn beliefs, and, above all, faith in humanity and zeal for the public good.

THE Right Hon. T. R. Ferens, High Steward of Hull, has presented to Hull the princely sum of 250,000*l.* as a nucleus towards a University College for the city. In his letter to the Lord Mayor announcing his intention of making the gift, Mr. Ferens stated that he had carefully consulted university professors and others interested in educational matters, and was satisfied that the time was arriving when Hull should join other cities, such as Birmingham, Manchester, Liverpool, Leeds, etc., in giving opportunities to its sons and daughters for higher education. We believe it was at the meeting of the British Association at Hull, when the retiring president, Sir Edward Thorpe, and the president, Sir Charles Sherrington, were the guests of Mr. Ferens, that the idea was first suggested. In addition to this magnificent gift, a new Art Gallery, costing something like 90,000*l.*, together with its site in the centre of the city, has been presented by Mr. Ferens

He has given more than 11,000*l* towards pictures for the permanent collection, without which the probability is the present Art Gallery in the City Hall would not have existed Other gifts of Mr Ferens include more than 9000*l* for the site for a new technical college, amounts set aside for scholarships, playing fields, almshouses, boating-lake, and similar objects

LONGEVITY among scientific men is exemplified in a signal manner through the ninetieth anniversary of the birth of a distinguished zoologist, the Rev T R R Stebbing, F R S, an event which occurred on February 6, and was duly celebrated at his home at Tunbridge Wells The record of the Stebbing family with the Royal Society, from father to son, is noteworthy when we recall that 1765, 1845, and 1896 are, respectively, years of family elections into that body Born in London, Mr Stebbing was the fourth son of the Rev Dr. Stebbing, many years acting editor of the *Athenæum*, indeed almost from its foundation in 1828. Incidentally, we may remark that the third son, Mr William Stebbing, for long Delane's right-hand man on the staff of the *Times*, is also alive Mr Stebbing's life studies in zoological science have been concerned principally with the Crustacea His report upon the Amphipoda of the *Challenger* Expedition occupies three quarto volumes, comprising 1774 pages of letterpress and 212 plates It was accompanied by a bibliography giving a critical report of everything that had been written respecting these Crustacea from the time of Aristotle to the year 1887 This detailed analysis occupies more than 600 pages, being in fact a complete history of the group Mr Stebbing has always been greatly interested in promoting local scientific societies His efforts in this connexion in the south-east of England, jointly with the late Mr George Abbott, were referred to in NATURE of February 7, p 201. Mr Stebbing was zoological secretary of the Linnean Society, 1903–1907, and Linnean medallist, 1908 We proffer our heartiest congratulations to him upon the auspicious occasion of a nonagenarian birthday

DR J. H. JEANS gave the sixteenth Kelvin Lecture to the Institution of Electrical Engineers on February 6. He chose as his subject electrical forces and quanta, and gave a masterly résumé of the theories of relativity and quanta Starting with Einstein's hypothesis he stated that the whole theory of gravitation and of electromagnetic forces can be worked out by pure geometry When, however, we come to the theory of quanta we have to determine the magnitude of the quantum, and so it is necessary to have recourse to experiment He considers that there is now no room for doubt as to the substantial accuracy of Einstein's relativity theory It provides a general dominating principle, to which all phenomena must conform It helps us to discover the laws according to which events occur, but has nothing to do with why they occur It is unscientific to suppose an ether unless there is an absolute necessity for it The hypothesis is unnecessary, in Dr Jeans's opinion, as the explanations are entirely satisfactory without it *A fortiori* it is hopelessly unscientific to presuppose two or more ethers In his opinion the last twenty-five years will rank as one of the most fruitful and important periods in the history of physics In an hour the lecturer covered a very wide field He touched on Rutherford's, Bohr's, and Sommerfeld's theory of the atom He pointed out that the explanation of line spectra is one of the most satisfactory in the whole range of physics, the numerical accuracy of the theory rivalling the most accurate of astronomical calculations He is of opinion that the theory of a mechanical ether believed in by Faraday and Maxwell is dead As soon as we pass beyond the minute range covered by the Newtonian mechanics and the classical electro-dynamics, the picture presented to us by the quantum dynamics takes us by surprise We find that Nature consists of a series of abrupt jumps These jumps are so minute and so close together that they produce the illusion of continuous motion, and no satisfactory mechanical explanation has yet been given

THE fourth annual report of the British Electrical and Allied Industries Research Association has now been published It is stated that the results obtained last year represent a real contribution to progress in the affected industries, but nothing of a spectacular character has been discovered Hitherto commercial research has been concerned mainly with the finding of the values of physical constants Little has been done in the way of obtaining new scientific knowledge It is stated that the discoveries of Sir J J Thomson and Sir E Rutherford are opening up immense fields of knowledge which may not only revolutionise existing methods of design but even alter the nature of the activities of the whole industry The Association is giving close attention to the possibilities of work in this direction It is considered, for example, that there is necessity for fundamental research on a large scale into the phenomena of dielectrics This of course is of great interest to the cable and therefore to the whole electrical industry We shall be very interested to note the results of these great schemes of co-operative research

THE late Mr Thomas L Gray, who died about a year ago, bequeathed the residue of his estate, which is expected to amount to about 7000*l*, to the Royal Society of Arts for the purpose of founding a memorial to his father, Thomas Gray, formerly head of the Marine Department of the Board of Trade According to the Society's journal, the bequest is to be known as "The Thomas Gray Memorial Trust," and the income derived from it is to be devoted to "the advancement of the science of navigation and the scientific and educational interests of the British Mercantile Marine" It is suggested in the will that these objects may be achieved by offering prizes for new inventions relating to navigation, by making grants for scientific research and for lectures on the subject, and by providing scholarships for students or teachers and offering prizes for essays on and awards for the saving of life at sea Thomas Gray

was in charge of the Marine Department during the 'seventies and 'eighties, when British shipping was developing rapidly, and took a prominent part in formulating the present system of regulation and control

THE issue of *Die Naturwissenschaften* for January 16 is devoted to an account of the foundation on January 14, 1845, of the Physikalischen Gesellschaft of Berlin by Profs Beetz, Brucke, Karsten, Knoblauch and Du Bois-Reymond, and its subsequent history Profs Warburg, Goldstein, Scheel, Pringsheim and Planck are responsible for an interesting and well-illustrated account of the Society and its activities The five founders are shown in the frontispiece, which in itself makes an interesting study of professorial attire Profs Clausius, Quincke, Kundt and Kohlrausch form another group, and separate portraits are given of Profs Riecke, Warburg, Brucke, Kirchhoff, Helmholtz, Halske, Weierstrass, G Wiedemann, Kronecker, Schwalbe, Werner Siemens, Hagenbach, von Bezold, Foerster, Planck and Goldstein As the Society developed out of the physical colloquium founded by Prof Magnus in Berlin in 1843, it is fitting that Prof Pringsheim's recent address to the Society on the Magnus effect, its theory as developed by Prof Prandtl and its application by Dr Flettner, should be given a prominent place and that the original figures of the Magnus paper should be reproduced

THE final sale of the Crisp collection of microscopes takes place on Tuesday, February 17, at Stevens's Auction Rooms, where in 1920 and 1921 the other portions of the collection were sold In the catalogue which Messrs Stevens have issued, 371 lots are detailed, arranged in groups —(1) Simple microscopes and small pocket compound microscopes, (2) compound microscopes dating from the seventeenth century to the introduction of achromatism in the early part of the nineteenth century, (3) optical cabinets, solar and projection microscopes The various Nuremberg wooden microscopes form another small group In each group, the instruments are catalogued approximately in chronological order Illustrations are given of fourteen of the earlier and more interesting instruments, including the unique silver microscope made by G Adams, a Hooke microscope, and original examples by Campani, Marshall, and Lindsay The whole collection, which consisted of about 3000 microscopes, was formed during the latter half of the last century by the late Sir Frank Crisp, Bart, who became the leading authority on the history and development of the instrument He frequently expressed his intention of presenting his collection to the Science Museum at South Kensington, so that it might become the property of the nation

AT a meeting of the Dominions and Colonies Section of the Royal Society of Arts on January 27, Mr W R Dunlop, lately professor of economics under the auspices of the Colonial Office, read a paper entitled "Economic Research in Tropical Development" Starting from the premise that the great question of economics is why some people, individually or collectively, are better off than others, Mr Dunlop said that useful and illuminating results can be obtained in the tropical world, by contrasting one country which is undeveloped and poorly off with another that is relatively highly developed and extremely well off Taking British Guiana in South America, and British Malaya in the East, the total population and external trade of the former in 1923 were 300,000 and 6,426,607*l*, while those of the latter were $3\frac{1}{3}$ millions and 147,945,860*l* As countries go, both are similar in size (comparable to the area of the United Kingdom), both are fertile, and both have mineral and other resources The difference in extent of development is fundamentally due to (*a*) difference in world geographical position, (*b*) difference in mineral resources, (*c*) internal geographical disadvantages in the case of British Guiana On the whole, British Malaya is also more efficient industrially than British Guiana Concerning efficiency in public administration, Mr Dunlop directed attention to the fundamental importance of transport, public health, land administration, forestry and scientific research of all kinds in tropical economic development Comparison of existing policies in these matters in British Guiana and British Malaya shows striking differences In conclusion, Mr Dunlop said that he used British Guiana and British Malaya as illustrations providing data and proof for demonstrating the nature of the research he was advocating.

APPLICATIONS are invited for some junior professional assistantships at the Meteorological Office Candidates must hold an honours degree in mathematics or physics Written applications should be addressed to the Secretary (S 2), Air Ministry, Adastral House, W C 2

THE Royal Aircraft Establishment, South Farnborough, Hants, is requiring a test assistant for aerial photographic work Candidates should possess some knowledge of chemistry, preferably photographic chemistry, and be medically fit for flying. Applications should be marked A 46 and be sent to the Superintendent of the Establishment

SIR OTTO BEIT, Bt, F R S, Sir Sidney Frederic Harmer, F R S, Director of the Natural History Departments, British Museum, and Sir Frank Short, Royal Academician, president of the Royal Society of Painter-Etchers, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

SHORTLY before 10 P M on February 1, a slight earthquake was felt in the south-west of Cornwall, at Penzance, Camborne, Truro, etc, and the Scilly Isles Records have also come from Brest and Jersey The disturbed area probably contained about 17,000 square miles, and its centre apparently lay to the west of the Channel Islands In the much stronger earthquakes of January 28, 1878, and May

30, 1889, the centre lay to the east of Jersey It has been suggested that the shock was due to the subsidence of disused mine-works, but the greatest known area disturbed by such earth-shakes is less than 150 square miles, and, owing to the small depth of the origin in such cases, the intensity is always great near the centre of the area and declines rapidly outwards

AT the annual meeting of the Royal Microscopical Society held on January 21, the following were elected as officers and members of the Council for the ensuing year *President*, Mr A. Chaston Chapman, *Vice-Presidents*, Prof F J Cheshire, Mr M T Denne, Sir Robert A Hadfield, Bart, Dr R J Ludford, *Treasurer*, Mr C F Hill, *Honorary Secretaries*, Mr J E Barnard, Dr J A Murray, *Members of Council*, Mr S C Akehurst, Mr E W Bowell, Rev Canon G R Bullock-Webster, Dr H G Cannon, Dr C Da Fano, Mr E H. Ellis, Prof R Ruggles Gates, Mr T H Hiscott, Mr J W Ogilvy, Mr D J Scourfield, Dr. C Tierney, Mr H Wrighton, *Librarian*, Mr R Paulson, , *Editor*, Dr J W H Eyre, *Curator of Instruments*, Mr. W. E Watson Baker, *Curator of Slides*, Mr E J Sheppard

AT the last meeting of the Illuminating Engineering Society on Jan 27, a paper was read by Mr. J W. T Walsh, of the National Physical Laboratory, Teddington, dealing with some little-understood aspects of the effect of shadows in lighting problems It is well known that the shadows cast by indirect lighting systems—for example, when light is received by reflection from a white ceiling—are so soft as to be inappreciable to the eye In fact such systems have sometimes been described as "shadowless" Mr. Walsh was able to show that what the eye cannot perceive the photometer can detect, and that in fact the obstruction of light by a person's body or adjacent machinery, etc, may in such cases cause a very marked diminution in the available illumination Similar conditions apply when one is dealing with daylight from a white sky, yielding ill-defined shadows Methods of calculating the ensuing loss of light were suggested. An interesting example of such effects was afforded by a room with white walls and ceiling which, when empty, appeared to be brilliantly illuminated, but when the room was occupied by bulky, dark-coloured machinery the illumination was found to be inadequate At the conclusion of the meeting it was mentioned that a special course of lectures, each given by an expert on some special aspect of illumination, is being arranged to take place at the Polytechnic, Regent Street, starting in April next

WITH its January issue *The Marine Observer* has entered upon its second year. The former Director of the Meteorological Office, Sir Napier Shaw, contributes an interesting communication, "A Meteorologist at Sea," a reflection on meteorology when traversing the Atlantic for the recent British Association meeting in Canada The reflection roughly compares official meteorology as undertaken by Admiral Fitz-Roy in 1855–1865 with official meteorology as controlled by Sir Napier from 1900 until 1924 At the commencement of Sir Napier's official career at the Meteorological Office, a quarter of a century ago, weather observations were obtainable only at the central weather offices of different countries, and the area embraced was very much limited Now the daily map obtained embraces practically the whole of the Northern Hemisphere It is only a little more than 60 years ago that charting the weather on daily maps was introduced into Great Britain by Admiral Fitz-Roy Much information is given in the periodical bearing on ships' wireless weather news, by means of which every opportunity is afforded seamen of constructing their own weather charts when at sea

IN the January issue of *Science Progress* Mr F W Shurlock, Principal of Derby Technical College, gives an account of the Rev A Bennet, F R S, curate of Wirksworth, near Matlock, and inventor of the gold leaf electrometer Unfortunately, the "Dictionary of National Biography" gives no account of Bennet and ascribes the invention of the instrument to George John Singer The "Encyclopædia Britannica" and Wiedemann's "Elektricitat" both give the credit to Bennet, and cite his paper in the Transactions of the Royal Society for 1787, in which the instrument is described It is dated "Wirksworth, Sept 14, 1786," and as Singer was born in this year there can be no question of priority Mr Shurlock quotes the description of the instrument, the method adopted for getting an electric charge from the air by means of a flame and the method of doubling the charge obtained Bennet's Royal Society papers form the basis of his book, "New Experiments on Electricity," published at Derby in 1789 He appears to have been a master at the Free Grammar School at Wirksworth, and there is a quaint portrait of him in the vestry of the parish church He became rector of Fenny Bentley near Ashbourne in 1796 and died there in 1799

THE "Arcadia" projector, shown in operation at the King's Cross Cinema on February 4, has several novel and distinct features Hitherto the projection of "living pictures" has been based on the use of an automatic shutter alternately opening and closing, and presenting a rapid succession of "still" effects. The shutter causes a rapid alternation of light and darkness and is liable to cause more or less flicker The new projector makes use of a complex arrangement of rotating mirrors, whereby successive pictures are imposed, but throughout the process there is substantially the same amount of light on the screen, and it is claimed that this removes one potential cause of eye-strain In addition the method gives rise to a certain degree of stereoscopic effect The mechanism of the projector and the method of feeding the film also present novel features, conducive to greater steadiness and more silent running, and the amount of wear and tear of the film is stated to be very much reduced A similar projector was demonstrated at the Imperial College, South Kensington, on February 10, 1921, and described in our issue of February 24, 1921, p 841.

THE recently amalgamated firms of T Cooke and Sons, Ltd, and Troughton and Simms, Ltd, 3 Broadway, Westminster, S W 1, which went into voluntary liquidation several months ago, inform us that this state of affairs has now been satisfactorily terminated They wish it to be known that their facilities for designing and manufacturing high-grade scientific instruments and apparatus in large quantities have been retained intact, so that they are able to deal with orders as hitherto

MESSRS Adam Hilger, Ltd, have recently issued a handsome catalogue of their various manufactures It includes thirteen sections and is provided with a thumb index for ready reference as well as a general index at the end The instruments described and illustrated in the sections come under the following headings —Echelon diffraction gratings and Lummer-Gehrcke parallel plates (including echelon gratings having as many as 56 plates), spectrometers and goniometers, wave-length spectrometers, monochromators and specialised spectroscopes, spectrographs, accessories for spectrometers and spectrographs (including, among other things, heliostats, vacuum tubes, thermopiles and high purity electrodes of copper, iron, carbon and nickel), spectrophotometers, colorimeters, and apparatus for sensitometry (including the new Judd Lewis sector photometer), diffraction gratings; micrometers, etc, polarimeters and refractometers; Michelson, Fabry and Perot, and Hilger interferometers, spectroscopic apparatus for high resolving power, optical work, and the Low-Hilger audiometer. The instruments are well described and appear to be constructed with the care and with the view of convenience in use for which this firm is well known It is unfortunate that they cannot be produced at a lower price, however, as many to whom they would be of great value will find some of the charges prohibitive.

MESSRS Gallenkamp and Co, Ltd, of 19 Sun Street, Finsbury Square, London, are to be congratulated on the new issue of their catalogue of apparatus for the examination of soil Until now, the recent striking advances in the technique of agricultural science, especially in physics and physical chemistry, have not induced the scientific apparatus firms and instrument makers to introduce the new apparatus to general notice This has been a real disadvantage to the research worker in soils It has usually been possible to persuade a firm to make a copy of some particular apparatus, the construction of which was beyond the ordinary laboratory facilities, but this is a very expensive way, as all the special costs are chargeable to the one apparatus On the other hand, when an apparatus is listed in a catalogue, not only does it bear a smaller share of the overhead charges, but the publicity usually results in increased sales, which act in the same direction Messrs Gallenkamp's catalogue is divided into five sections soil sampling tools, physical properties of soil, soil solution, chemical analysis of soil, and soil meteorology Each of these sections contains items that well show the recent advances in the technique of agricultural science The newer forms of soil sampling tools are to be commended, and in the sections on physical properties of soil and soil solution, prominence is given to apparatus devised at the Rothamsted Experimental Station. The section on soil meteorology has been carefully thought out and should be of considerable use in the development of work that, coming on the border line between meteorology and soil physics, has been rather neglected

MESSRS Longmans and Co have in preparation a new and cheaper edition of Thorburn's "British Birds." The work will be in four volumes, illustrated by 192 coloured plates reproduced from new drawings by the author It is hoped to issue the first volume in March, the second in the autumn, and the remaining two volumes in 1926

SOME 1900 books on geology, palæontology, and mineralogy from the libraries of the late Sir Jethro J H Teall, and Messrs T W Reader and E. A. Walford, are offered for sale in Catalogue No 123 by Messrs Dulau and Co, Ltd, 34 Margaret Street, W 1, together with a number of other works on fossil plants, anthropology, archæology, and zoology Copies of the catalogue can be obtained on application

Our Astronomical Column.

PHOTOGRAPHY OF THE ASTRONOMISCHE GESELLSCHAFT ZONES —Prof Schlesinger gave an interesting account at the meeting of the Royal Astronomical Society on Jan 10 of the reobservation by photography, at Allegheny Observatory, of some of these zones The novelty of the method lies in the size of the plates used, some of which are 5° in the side, others 12½° The lens is a triple one, and the only form of distortion present is a tendency for bright stars to appear slightly displaced away from the centre as compared with faint ones, the amount near the edge is 0·06″ per magnitude As each star is present on at least two plates, with the shift generally in opposite directions, no systematic magnitude error is introduced

Although the scale is only half that of the Astrographic plates, the excellence of the lens is such that the probable error of each star image is only 0·18″

Incidentally, the measures give the means of determining magnitude error in the Astr Gesell Catalogues For on plotting the differences of R A., Allegheny *minus* A G, for different magnitudes, the abscissa being Right Ascension, sine curves are obtained due to the solar motion The zero line of these curves is found to alter with the magnitude, now as magnitude equation on the photographs is shown to be eliminated in the mean, the effect must be due to the equation in the A G Catalogues

Prof Schlesinger is on his way to South Africa to inaugurate the photographic work with the instrument which is being sent there from Yale Observatory. He hopes to return in time for the meeting of the Astronomical Union at Cambridge in July It may be mentioned that the 12½° × 12½° plates are a quarter of an inch thick and weigh 10 lb It would only need some 270 of these plates to cover the entire celestial sphere, so that the taking of the plates is a much less serious matter than that involved in the Astrographic Catalogue The chief labour lies in the measurement and reduction.

Research Items.

The Preservative Properties of Hops.—For many years it has been assumed that the preservative properties of hops are directly proportional to the percentage soft resin content. In view, however, of the objections inherent in Brown's method of evaluating the former, it is welcome to find in a recent paper by Mr. A. Chaston Chapman (Jour. Inst. Brew., 1925, xxxi. 13) the description of an improved biological method. To varying amounts of a 1 per cent. aqueous infusion of the hops, in a medium of nutrient agar, were added a few drops of a culture of an organism isolated from raw sugar, and specially sensitive to the inhibitory effects of hop extract. After incubation for 18 hours at 37° C. on petri dishes, the mixtures were arranged in order of bacterial development, the end-point being represented by a dish containing few or no colonies, followed by one containing a large number. The end-points were sharp and concordant, and within reasonable limits, were independent of the strength of the infusion and of the number of successive digestions of the same sample. The author suggests that the preservative material, though highly insoluble, is being produced continuously during the extraction. Whereas no quantitative connexion between the soft resin content and the preservative value is apparent, experiments on the cold and ordinary storage of hops show that both these properties diminish at a slower rate in the former case. Apparently the two properties are associated in some way not yet clear, the quality rather than the quantity of preservative material being the important factor. Methods of estimating resin content by direct extraction are criticised, and an improvement giving higher results is suggested for soft resins. These are now extracted in a Soxhlet apparatus by petroleum ether from the total resin solution spread on an Adams milk-analysis paper.

Deterioration of Structures in the Sea.—The fourth (interim) report of the Committee of the Institution of Civil Engineers on the Deterioration of Structures in Sea-water was published in December 1924, although the report itself is dated September 1923 and deals, for the most part, with investigations carried out in 1922. It includes a paper by Mr. E. J. M'Kaig and Dr. J. Newton Friend describing a steel landing-stage at Weston-super-Mare which, after standing for fourteen years, developed structural defects and had to be taken down. One point of interest was the unexpectedly large amount of corrosion at the point where the piles entered the sea-bottom, due, apparently, to the slow drift of sand against the piles. Other evidence also suggests that a very slight amount of mechanical wear greatly accelerated the chemical action of the sea-water on the steel. Investigations relating to the preservation of timber from marine boring animals are reported on by Prof. G. Barger and Mr. C. M. Yonge. As the work of the latter only extended over a period of six weeks, it was scarcely to be expected that much would be added to our knowledge of the life-history of Teredo. The results of experiments in poisoning the larvæ with the arsenic compound "D.M." are in striking contrast to the American observations recently reviewed in Nature (November 22, 1924, p. 745). The species studied at Plymouth by Mr. Yonge was identified as *Teredo norvegica*; Prof. Barger does not give the name of the species which he observed at Lowestoft, but as he refers to "Teredo" as a "species," it is plain that he does not consider the point of much importance. An account is given by Mr. J. M'Glashan and the late Dr. N. Annandale, of damage done to brickwork in the Calcutta docks by the boring mollusc *Martesia fluminalis*. It should have been mentioned that Dr. Annandale's report printed here was published more than a year ago in the Journal of the Asiatic Society of Bengal (vol. xviii. No. 10, p. 555).

Extinct Rhinoceroses of China.—The Geological Survey of China has published an important work by Dr. Ringstrom of Upsala on the Rhinoceros and Hipparion Fauna of North China (Provinces of Shansi, Shensi, and Honan). The present volume is part iv., series C of volume 1, 1924, and deals entirely with the rhinoceroses. In it a new genus of the short-legged teleocerine rhinoceroses is described under the name Chilotherium. A new genus of great interest, Sinotherium, of which Ringstrom had already published a preliminary account, is also here more fully described. The genus is closely allied to Elasmotherium, that curious rhinoceros with extraordinary complicated teeth and large hump over the eyes and nose, of which the British Museum has recently acquired a fine skull. The paper is fully illustrated with many text-figures and twelve plates, and its value is further enhanced in that the author gives his views on the position of certain Asiatic and European rhinoceroses.

An American Extinct Fauna.—A bulletin of the American Museum of Natural History (vol. 50, article 2) contains a third part of Dr. W. D. Matthew's studies on the Snake Creek fauna. In it will be found a short notice of the stratigraphy of these important Miocene and Pliocene quarries whence the specimens came, together with remarks on the distinctions between the faunal zones and correlation of the faunas. The list of the vertebrate fauna, numbering more than a hundred species of mammals and including the celebrated tooth of *Hesperopithecus haroldcookii*, together with a sprinkling of birds, reptiles, and amphibia, is an impressive one. The bulk of the paper is devoted to an account of the various forms and, as is usual with this author, is no mere dry description, but is illuminated throughout by his discussion and views as to the evolution and relationship of the various forms, such as the phylogeny of the Canidæ and questions concerning the horses.

The Meteor Crater of Arizona.—The Indians of Northern Arizona have a legend that a god visited them from heaven in a great chariot of fire which illuminated the sky and finally disappeared into the ground. It seems probable that the chariot was the gigantic meteorite which has been held responsible for the origin of the remarkable crater of Canyon Diablo. That the impact theory is correct seems to be established by the work of D. M. Barringer (Proc. Acad. Nat. Sci. Philadelphia, 1924, p. 275). He predicted in 1909 that the main bulk of the meteorite would be found under the southern wall of the crater. An exploratory boring has now been sunk near the southern rim, and at a depth of 1346 ft., highly oxidised meteoric iron was met with. After passing through 30 ft. of this material the tools jammed, and no further progress was possible. Barringer considers the main meteorite approached the earth from the north at an angle of roughly 45°, leaving a scattered trail of the well-known Canyon Diablo meteorites. These have been found to contain platinum, and according to the *Winslow Mail*, of Arizona, a company has now been formed

to mine the deeply buried mass, which has been estimated to weigh a thousand million tons, by running drifts into it from the low country to the south of the crater rim The unique history of Meteor Crater should therefore be gradually disclosed during the next few years more completely than could ever have been anticipated before the possibility of platinum suggested mining exploitation

PETROLEUM ITS GENESIS AND GEOLOGY —An article from the pen of Prof James Park and bearing this title appeared in the September number of the New Zealand Journal of Science and Technology (1924), it presents a very fair résumé of the subject, though it was obviously written for the purpose of general knowledge rather than to pave the way for possible oil explorations within the Dominion From the tectonic point of view New Zealand, as is the case with Australia, does not offer inducement as a country of potential petroleum reserves, though evidence of oil is by no means lacking, this does not, however, imply accumulation on a commercial scale The author makes the interesting statement that "The seepages of oil found at Taranaki, and at Waiotapu in the King-country, New Zealand, occur in Tertiary rocks, and there is good reason for the belief that the oil has originated from the destructive distillation of the underlying seams of lignitic coal" This theory, even if well founded, tends to make it all the more improbable that there is any economic future for oilfield development in this country This is the only specific reference to petroleum in New Zealand In the paragraphs discussing the general geology of petroleum, the author refers to the porosity of oil-sands and states that "a porosity of 10 per cent is equal to 750 barrels of oil per acre-foot The recoverable oil ranges from 50 to 75 per cent of the oil in the sands" This last sentence is open to some doubt, especially with present-day methods of oil production, in practice a 30 per cent recovery is considered good, Uren places the maximum at about 40 per cent, and with a 25 per cent porosity and complete saturation this could probably be achieved Writing of oil migration, the author attributes this to "the differences of the specific gravities of oil and water" as being "the most powerful cause", the researches of Munn and others have demonstrated clearly that movement and pressure of underground water are far more potent causes, as, indeed, may be gas pressure and capillary attraction The article is, on the whole, a curious mixture of orthodox statement and original comment, it is in many respects to be regretted that the author does not also give us a fuller description of the known occurrences of bitumen in his country, notwithstanding that they may have little commercial value

SOME USES OF PEAT —One commonly regards peat in domestic use as a form of clean, cheap, though not always very efficient fuel, and such it probably is in most countries It may come as a surprise to some people, therefore, to learn that in that land of varied and abundant fuels, the United States, by far the greatest quantity of peat produced is utilised in the form of fertilisers or as an ingredient of fertilisers, no less than 57,907 tons being marketed for this purpose in 1923, at a gross value of 351,641 dollars The bulk of the United States peat comes from Illinois, New Jersey and California contributing the second and third largest outputs respectively The use of peat as a stock-food is the next important activity in the industry, more than 3000 tons being produced for this purpose in the same year As a fuel, the production (hence consumption) was practically negligible, in fact no return was made at all for 1923, and only 1040 tons were thus absorbed in the previous year Other uses (according to Mr K W Cottrell in Mineral Resources of the United States for 1923, part 2) include its employment as peat moss, stable litter and packing material, much of which is included under the annual return for stock-food A somewhat curious fact is that peat moss imported for consumption in the United States has shown a steady increase during five years from 1919, when 464 tons were introduced, to 1923, when nearly 600 tons at a value of 43,184 dollars were imported, presumably from northern Europe, where the Sphagnaceæ are important constituents of peat Peat rich in these mosses has in other countries been successfully used in the manufacture of blankets, rugs, cardboard and cork-like materials, and it may be that some such use is being found for it in the United States, though the present report makes no mention of the purpose for which peat moss is being imported

RESOURCES OF ARCTIC RUSSIA —Under the Scientific-Technical Department of the Supreme Council of National Economy, Transactions of the Northern Scientific and Economic Expedition, Petrograd and Moscow, 1920–1924 (*in Russian*), are published the results of several expeditions for the exploration of natural resources of Arctic Russia The publication appears in separate parts, each one dealing with a special problem Most of the work has been directed towards the exploration of the mineral wealth of the country, and many important discoveries are recorded. Thus the report by I I Ginsburg (No 7 of the Transactions, pp 64) contains an exhaustive survey of the mineral resources of the coasts of the Kandalaksha Gulf of the White Sea, where gold has been found and extensive beds of mica have been studied; local silver and lead ores are also described, and sketch maps of mineral resources are given No 18 of the Transactions (pp 75, 1924), by Beliankin and Kupletsky, and No 20 (pp 43, 1924), by Beliankin, Vlodavez, and Shimpf, contain further information on the mineral resources of the same territory collected during the expeditions of 1917 and 1922 respectively, these two papers include also considerable data on petrography and geology of the country No 16 of the Transactions, by A Fersman (86 pp, 1 map, 1923), includes a series of abridged reports of different authors on the results of expeditions to the Khibin ridge of the Kola peninsula, where a very extensive geographical, geological, and geochemical survey was organised during the years 1920, 1921, and 1922, full reports of the expeditions will be published in two volumes when all the materials collected are worked out Paper No 19 (pp 102, summary in English), by Prof K N Derjugin, presents results of exhaustive hydrological and biological exploration of the Barents Sea during the years 1921–1923 The author gives new evidence to prove that, besides the annual oscillations of temperature of water, there exist periodic variations in the Atlantic currents which appear to be subject to a cycle of 8-9 years Other hydrological elements, distribution of salinity and of oxygen, degree of transparency of water and character of ground, are also discussed Lists of fauna are given (including descriptions of several new forms), and the conclusion is reached that the fauna of the Barents Sea is not arctic, but only sub-arctic, in its composition The authors believe that periodical variations in the thermical state of the Barents Sea have a strong influence on the climate of Northern Europe

WEATHER IN RHODESIA —The Proceedings of the Rhodesia Scientific Association, vol xxii, contains a discussion on "The Problem of Seasonal Forecasting," by Mr C L Robertson The method of

cycles is dealt with, but the longest local record available is only continuous for 35 years, which is quite insufficient Severe droughts are said to occur within a year or two of sunspot minima and heavy rains within a year or two of sunspot maxima A 19-year cycle, based on pressure variations, is suggested as influencing Rhodesian weather Maps are given showing the variations of pressure over the globe for the months of February, May, August, and November Reference is made to the pressure values in the southern hemisphere to show the relation to Rhodesian weather Areas of high pressure, important centres of action for South African weather, are shown in the South Indian, South Atlantic, and South Pacific Oceans There is a movement of these centres to the north and south, and also to east and west The tracks are said to deviate from an average mean track, and the 19 years' periodicity is attributed to this movement. Much detail is given with reference to the various cycles, and the inquirer will find much of interest A connexion is referred to between the south-west monsoon rainfall in India and the rainfall along the east coast of Africa down to Rhodesia Based on the assumptions obtained, seasonal forecasts are being made and probably in time some success will be gained

HYDRODYNAMICS AND ELECTRICAL ANALOGIES —In the December issue of the *Journal de Physique*, Prof. V. Bjerknes shows how the general equations of hydrodynamics may be transformed so as to exhibit the close analogy between the movements and forces in the fluid and the currents and forces in electrodynamics By means of rotating cylinders, and arrangements for producing bodies the volumes of which pulsate about a mean value, or oscillate about mean positions, he has shown that the analogy is true experimentally. He points out that both his theoretical and his experimental work are but generalisations and improvements of results published by his father forty-five years ago Amongst the analogous systems referred to by the author may be mentioned the lines of flow about a pulsating sphere and the lines of force about a magnetic pole, the lines of flow due to an oscillating sphere and the lines of force of a short magnet, the lines of flow due to two parallel cylinders rotating in opposite directions and the lines of force due to two parallel electric currents flowing in opposite directions, a cylinder rotating in a stream of fluid (the Magnus effect) and a wire carrying electric current in a magnetic field

HEATS OF OXIDATION —The heats of oxidation of certain metals in a pure state have been redetermined by J. E Moose and S W Parr (J Amer Chem Soc, Dec 1924). A very accurate bomb method was used. The values, in calories per gram of metal, for some of the more important metals are aluminium, 6970, beryllium, 14,879, zinc, 1298, magnesium, 5996, cerium, 1661

ISOLATION OF HYDROXYLAMINE —C de W Hurd and H J Brounstein, in the Journal of the American Chemical Society for January, describe a new method of isolating free hydroxylamine from the hydrochloride The latter is decomposed with a butyl alcohol solution of sodium butylate, the sodium chloride is filtered off and the filtrate cooled to $-10°$, when half the hydroxylamine crystallises out Methods of utilising the half remaining in solution are described.

ATOMIC WEIGHTS OF SILVER AND CARBON —The atomic weights of silver and carbon have recently been determined by Dr G Dean by the reduction of pure silver cyanide and cyanate in a current of hydrogen (J Chem Soc., Dec 1924) Assuming $O=16$, $Ag=107.88$, and $N=14.008$, then the ratio AgCN : Ag gave $C=12.002\pm0.001$ Similarly, the ratio AgCNO : Ag gave $C=12.003\pm0.001$. By combining these ratios, and assuming only that $O=16$, then $Ag=107.871$, and the radical $CN=26.008$, which, on subtraction of 14.008, gives $C=12.000$

ELECTROLYSIS OF SOME ORGANIC SALTS —The electrolysis of salts of some alkyloxyacids is described by D A Fairweather in the Proceedings of the Royal Society of Edinburgh (1924, vol 45, Part I, No 4) The potassium salts of ethyl ethoxymalonic, ethyl diethoxysuccinic, and ethoxyacetic acids, and sodium amyloxyacetate were used The chief products are of an aldehydic nature Hofer and Moest's explanation of the formation of formaldehyde from the electrolysis of sodium glycollate is shown to be applicable to the cases studied, in one case (potassium ethyl ethoxymalonate) the intermediate compound postulated by these investigators was identified in the electrolysis products, owing to its being quite stable

CARBONISATION TESTS —The Fuel Research Board has issued a Technical Paper No 10 on the carbonisation of a South Wales gas coal (Meiros Colliery, Llanharan) in Glover-West continuous vertical retorts The report gives the results of carbonisation tests resembling in scope and procedure those made on several gas coals from other coalfields (See F R B Report, 1920–21, and Technical Paper No 8) In particular, the effect of steaming was observed and the variation in the results obtained when the percentage of steam was increased from nil to 20 per cent of the coal treated The results are fully tabulated and summarised in conjunction with those obtained from other gas coals, which they follow in general lines The tests form a part of the scheme of the Board to prosecute a survey of the national coal resources, and the compilation and ascertainment of such results will undoubtedly have a value which will be greater as the data available become more complete

EXPANSION OF ALLOYS —The eighty-fifth report from the Research Institute for Iron, Steel, and other Metals, Sendai, by Kotaro Honda and Yosikadu Okubo, deals with the measurement of the coefficients of thermal expansion for certain alloys. The apparatus used was the same as that constructed some years ago by Honda It is a modified form of Chevenard's dilatometer The entire apparatus can, if necessary, be enclosed in a bell jar which can be evacuated so that the oxidation of metal specimens is avoided Data are given for certain aluminium alloys, particularly those used in aviation The results obtained with alloys of iron and nickel are interesting On adding nickel to iron, the coefficient of expansion decreases slightly up to 18 per cent of nickel and then increases to 25 per cent From 25 per cent it decreases rapidly to 36 per cent and afterwards increases, rapidly at first, and above 50 per cent gradually, up to pure nickel These results coincide with those of Guillaume, the alloy of minimum coefficient of expansion being approximately of the same composition as that of invar So far as iron-cobalt alloys are concerned, the variations are much smaller On adding cobalt to iron the coefficient of expansion decreases gradually to a minimum of 48 per cent, and rises gradually to the concentration of pure cobalt.

The Water Supply of Egypt and the Sudan.

IN the report recently issued[1] by the Physical Department of Egypt on the discharges and levels of the Nile and the rains of the Nile Basin for 1919, we have a revival of the reports on the rains of the Nile Basin which, after appearing for eight years, were discontinued on the outbreak of the War

This report differs from its predecessors in an important respect, the volumes discharged by the Nile and its tributaries now take the first place, and the rainfall measurements form but a minor portion of the volume This is an indication of the advance which has been made in late years by the Physical Department in the accurate gauging of the Nile supply, a matter of the highest importance both to Egypt and to the Sudan While formerly most of the determinations were dependent on the accuracy of curves constructed to show the relation between a gauge reading and the corresponding volume of the discharge, we are now presented with no less than 465 measured discharges taken during the year 1919 Of these 210 were on the Blue Nile, 74 on the White Nile, and 138 on the main stream This gives a precision to the results and an authority to the deductions which may be drawn from them that puts the hydrographic work on the Nile on a very high level

The discharges have been measured with Gurley's pattern of current meter, and these instruments are rated from time to time at Cairo It has been suggested that discharges measured during the flood are too large in consequence of the meter being affected by the turbulency of the water, but recent experiments by Mr B H Wade show that this effect has been much overestimated

The characteristics of the Nile regimen are well brought out in the table, the low stage flow of only 50 cubic metres per second of the Blue Nile in April, and the rapid rise to 8000 cubic metres per second at the beginning of September, in a year when the Abyssinian rainfall was about 30 per cent below the average, shows how vast a volume of water pours down to the Sudan and Egypt at this season of the year There is at this time ample water for the needs of the Sudan in the neighbourhood of the Blue Nile when Egypt is receiving more than its land can possibly utilise

The discharges of the White Nile show a wholly different type of supply, it varied from about 600 cubic metres per second in April and May to 1300 cubic metres per second in October and November, an increase due to water brought in by the Sobat river, which in 1919 received an unusually small supply from the southern plateau of Abyssinia

There are now 48 river gauges on the Nile and its tributaries south of Wadi Halfa which are read regularly, besides 9 on Lakes Victoria, Kioga, and Albert in Uganda

The rainfall throughout the Nile Basin is presented in a series of tables, and in most places it was below the normal in 1919 Consequently the level of the lakes on the Lake Plateau of Uganda fell generally, on the Bahrel Jebel the summer rainfall was good, but the extent of marsh in this region prevents the discharge in the lower reaches from gaining by it. The rainfall on the Abyssinian plateau was considerably below the normal, so that the volume passing Wadi Halfa was below the average throughout the year except in July, August, and September, and in November the defect reached 23 per cent

When we remember that the Nile for the last two thousand miles of its course flows through arid or semi-arid regions, the importance of accurate hydrographical information such as this cannot be overestimated

H. G L

[1] Ministry of Public Works, Egypt Physical Department "The Discharges and Levels of the Nile and Rains of the Nile Basin in 1919" By P Phillips Physical Department Paper No 11 (Cairo Government Publications Office, 1924) P T 5

Occurrence and Use of Bitumen.

IN a recent report (No 625) of the Mines Branch of the Canadian Department of Mines, Mr Sydney C Ells contributes a summary account of the nature, mode of occurrence, exploitation, and commercial development of the famous "tar sands" of Northern Alberta, Canada The report forms an appendix to the author's former "Preliminary Report on the Bituminous Sands of Northern Alberta," No 281, published in 1914, but for some years out of print The present summary contains the results of further field-survey of the deposits, including examination and sampling of the sands, a résumé of modern methods of recovery of the bitumen from the sand, and some data concerning the laying of demonstration pavements and roadways

The principal area of exposure of these sands is along the Athabasca River, outcrops occurring for a distance of more than 220 miles. The deposits are probably of Cretaceous age, though the origin of the bitumen is uncertain, a question which, however, is to form the subject of a report already in preparation The impregnation varies with the texture of the sand, as would be expected, medium and moderately compact deposits being the richest, finely-graded material being the poorest in bitumen content Attention is directed to the existence of impervious partings or strata within the deposits which act as horizons of concentration of the bitumen from overlying sands, presumably by downward migration The more fluid seepages, known as "tar springs," are shown to have originated by lateral migration from slightly inclined beds of particularly rich, coarse-grained sand, the author states that such springs are not of commercial value as sources of bitumen, and further, that it is erroneous to regard them as indications of oil-pools, as has been done by certain geologists who have studied this region The average bitumen content ranges from 20 per cent to 25 per cent in the richest deposits, to 15 per cent. in the normal impregnated sands, the crude bituminous sand has a gravity of 1 75 and a moisture factor of 1 3 per cent

The commercial application of this material to paving and road construction must be considered as still being in the experimental stage, though results based on eight years of observation on a highway surfaced in three different ways, namely, with sheet asphalt, bitulithic and bituminous concrete, are certainly encouraging, since at the time of writing the author states that "the pavement [*i e* road surface] was still in first-class condition, and had required no repairs," notwithstanding that heavy traffic included, apart from motor cars, vehicles carrying loads up to ten tons Crude bituminous sand is not recommended *per se* as paving material owing to its unbalanced mineral aggregate, lack of uniformity and to freight charges, though it is considered that an attempt should be made to produce an artificial mixture in which the inherent properties and qualities of the sand can be utilised to the greatest advantage The report concludes with a valuable summary of processes employed for refining bituminous deposits of this character.

University and Educational Intelligence.

LEEDS —Applications are invited for a lectureship in bacteriology, particulars of which may be obtained from the registrar The latest date for the receipt of applications is February 23

LONDON —On Monday, February 23, Prof W T Gordon will begin a course of twelve Swiney lectures on "The Geological History of Plants," at King's College, at 5 30 o'clock The succeeding lectures will be given on February 25, March 2, 4, 9, 11, 16, 18, 23, 25, 30, and April 1 Admission will be free

A free public lecture (in English) on "The Relation of Paralysis Agitans to the Parkinsonian Syndrome of Epidemic Encephalitis" will be given in the Lecture Hall of the Royal Society of Medicine, 1 Wimpole Street, W 1, by Prof R Cruchet, of the University of Bordeaux, at 5 o'clock on Wednesday, February 25

A course of four public lectures on "Puerperal Sepsis" will be given by Prof B P Watson, at St Thomas's Hospital Medical School on March 2, 3, 4, and 5, at 5 o'clock

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PROF WIELAND of Konigsberg has been offered the chair of pharmacology at the University of Frankfurt

DR FRITZ HILDEBRANDT, lecturer at the University of Heidelberg, has been offered the chair of pharmacology at the Medical Academy in Dusseldorf

DR PERCY BRIGL, first assistant at the Institute of physiological chemistry in the University of Tubingen, has been nominated professor and director of the Institute of Agricultural Chemistry at the Agricultural Hochschule at Hohenheim

DR FRIEDRICH PASCHEN, who was recently appointed president of the Physikalisch-Technische Reichsanstalt, has been elected to an honorary professorship in the philosophical faculty of the University of Berlin

NOTICE is given that the examinations for the award of the Tate Scholarships in engineering, science, and domestic science at Battersea Polytechnic for the session 1925–1926 will be held on June 9 and succeeding days The annual value of the scholarships is from 20*l* to 30*l* each, with free tuition, and the tenure is three years The last date of entry is April 18

A LECTURER in botany at University College, Colombo, will shortly be appointed Candidates for the post must hold a first-class honours British degree, with botany as the principal subject, or have equivalent qualifications, and should have had experience of lecturing or teaching Particulars of the appointment and copies of the necessary forms of application are obtainable from the Private Secretary (Appointments), Colonial Office, Downing Street, S W 1 The completed forms must be returned by at latest March 1

A JUDICIAL decision of interest to all who are concerned with educational finance was announced in the November number of *School Life*, the official journal of the Washington Bureau of Education. The Supreme Court of Oklahoma upheld the validity of a State appropriation to aid in paying teachers' salaries in districts that had levied the maximum school tax and still could not maintain their schools The court held that the burden of education rests on the State, and that the local rates are in the nature of aid to the State, which is bound to take such measures as are necessary for financing the school system, so as to afford equality of opportunity throughout the State

Early Science at Oxford.

February 15, 1683–4. Mr Aston sent an account of ye ascent of water in a bolt-head, a great while *before* freezing, and that a peice of Ice, of $3\frac{1}{4}$ inches thick, 4 broad, and a foot long, bore, in ye middle, ye weight of 350 lb, but with 400 lb, after some time, it broke, and (which is most surprising) that ye ice on ye Thames of late was not above 11 inches thick The same letter told us, that Ice was asserted to be to water in weight, as 7 to 8 which differs not much from Mr Desmasters late experiment

Then my Lord Bishop of Ferns his Discourse, concerning Acousticks, and ye severall ways of improving the sense of hearing, was read

Mr Ballard acquainted ye company with his success in some late Experiments performed by order of ye company A part of ye Rosemary stone (lately shewn us by Dr Plot) after calcination in a charcoale fire, apply'd to a magnet as well as that which had been calcined in a seacoale fire He chose to calcine it in a charcoale fire, haveing some suspicion it might receive some particles of iron, from ye seacoale, for he has formerly observed seacoal to be a kind of imperfect, or unripe iron-ore, because by an excessive heat of a forge it will flow, like molten metals, and then run to ye bottom of ye fire, where, haveing now lost all its combustible parts, it presently grows dead, and looking black, is cast out, a perfectly burnt cinder

1686–7 —A letter from Dr Garden of Aberdeen, Dec 8, to Dr Plot, gives an account of ye generation of ye small caterpillar, which infests blossoms of peares and apples, and destroys ye fruit viz that they are not bred of mists and dews as Godartius thinks, but of eggs, from whence he draws several other inferences

February 16, 1685–6.—Mr Ash, secretary of the Philosophical Society of Dublin, described the case of a woman in ye North of Ireland, who fasted for ye space of eighteen weekes, and did not speak in almost all that time —This gave Dr Plot occasion to mention a silent woman now living at Wanborow in Wilts, who has not spoke in near twenty yeares, of whom he promises to procure a more full relation

February 17, 1684–5.—A Nyctalops, or case of night-blindness, was described by Dr Briggs Being a schoolmaster, and able to answer such queries as shall be proposed to him, the Society agreed to send a list of queries, among which were Whether this Person can see by Candle-light, in a darke room, any time of the Day ? Whether, at any time, by candle-light darted through a Ball of water ? Whether by ye light of Glow-wormes, rotten wood, Herrings heads &c ? Whether at any time, and by any light, with ye Bishop of Ferns his Spectacles ? Whether his Eyes are equally affected ?

A description of the Cicindela volans, by Mr. Waller, F R S was read, and Dr Plot affirm'd, that this Insect has been observed in Staffordshire

Mr Walker brought in an account of the prices of ye best wheat and mault at Oxford on the market-dayes next before Lady-day and Michaelmas for twenty yeares last past by which it appeares, that the price of wheat for twenty yeares last past at a mean rate (*i e* one year with another) has been 5*s* $4\frac{1}{4}$*d* ye bushell mault, during the same time, in ye same market, at a mean rate, has sold at 2*s* $11\frac{1}{2}$*d* ye bushell

Mr Cole promised patterns of Dyes of seven distinct colours from his Shell-fish, viz white, a fine yellowish green, a fair deep sea-green, a deep Watchet blew, a sullen purple, a deep dark sanguine, and ye bright Tyrian purple

Societies and Academies.

LONDON

Royal Society, February 5.—H. M. **Carleton**: Growth, phagocytosis and other phenomena in tissue cultures of fœtal and adult lung. Invasion of the medium in a growing culture is the result of :—(1) Sheet-like epithelial outgrowth from the alveolar epithelium of cut alveoli. (2) Radiating growth of fibroblasts from the connective tissue of the lung. (3) "Membrane-formation," in which the cells of the cicatricial epithelium detach themselves from the implant. Within the implant there occurs a swelling up, and a detachment of, the alveolar epithelial cells. Mitoses are frequent in these—even in cultures of adult lung. Sterile coal or carmine particles are actively phagocytosed by both fœtal and adult lung *in vitro*. The alveolar epithelial cells are actively phagocytic, the dedifferentiated cells of the cicatricial epithelium less so.—F. W. **Fox** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part XIV.—The cholesterol metabolism in normal breast-fed infants. During the first week of life there is a daily average negative balance of 0·14 gram. This is to a large extent accounted for by the fact that the meconium is being got rid of. During the second and third week of life the average intake and output in the cases examined practically balance. At this stage the composition of the milk is in a transitional state from colostrum to true milk. In the last group of infants, from the seventh week to tenth month, there is an excess of intake over output, and the average positive balance is 0·069 gram per day. There must be some organ in the body capable of synthesising cholesterol, but the sterol present in the diet of infants is a source of supply which cannot be disregarded.—H. H. **Thomas**: The Caytoniales, a new group of angiospermous plants from the Jurassic rocks of Yorkshire. The fossils are the remains of megasporophylls with carpels, fruits, and seeds of two distinct types, and male inflorescences bearing stamens. They were found in the Gristhorpe Plant Bed in the Middle Estuarine Series, exposed on the Yorkshire coast in Cayton and Gristhorpe Bays. The species *Gristhorpia Nathorsti* gen. et sp. nov. had pinnate megasporophylls 4-5 cm. long, with an axis about 1 mm. wide; the sub-opposite pinnæ terminate in small more or less spherical carpels 2-5 mm. in diameter. The carpels have a stigma at the base near the pedicel. Winged pollen-grains were found on some of the stigmas. The seeds had a well-developed megaspore membrane with an apical projection, above which was a micropyle lined with cutinised cells. *Caytonia Sewardi* possessed megasporophylls agreeing generally with those of Gristhorpia, but the stigma was a small basal flange. The carpels and fruits contained two rows of ovules or seeds, with hard woody or stony testas. The remains of the male inflorescences are of a type previously known as *Antholithus* sp. and now named *Antholithus Arberi*. They were probably borne on the same plants as *Gristhorpia Nathorsti*. The anthers were four-lobed sessile structures, of a form very like that found in many modern Angiosperms, and had a longitudinal dehiscence. There are no traces of perianth members or bracts. There is a constant association of megasporophylls and fruits with leaves of *Sagenopteris Phillipsi* (Brongn.). The comparative examination of the cuticular structure of the axes of Gristhorpia and Caytonia and of the petioles of Sagenopteris fronds, makes it probable that Sagenopteris must be regarded as the leaf of the Caytoniales.—Winifred Brenchley and H. G. **Thornton**: The relation between the development, structure and functioning of the nodules on *Vicia Faba* as influenced by the presence or absence of boron in the nutrient medium. In the absence of boron the vascular supply of the nodule is defective. The strands are often entirely absent, or weakly developed. In plants grown without boron the number of nodules that attain macroscopic size is much reduced. In the nodules without vascular strands, the bacteria do not swell out to form the so-called "bacteroids." When weakly developed strands enter the nodule, the amount of tissue containing bacteroids is closely correlated with the extent of the strands. In the plants bearing these abnormal nodules very little nitrogen is fixed, the quantity fixed per nodule being, in one experiment, less than one-tenth of that fixed in normal plants. In the absence or weak development of vascular strands in the nodule, the bacteria tend to become parasitic. This change in relations between micro-organism and host is connected with loss or reduced supply of carbohydrate energy material normally brought into the nodule by the vascular strands.—A. S. **Rau**, F. W. R. **Brambell** and J. B. **Gatenby**: Observations on the Golgi bodies in the living cell. The so-called "nebenkern" of molluscan germ-cells is the Golgi apparatus, and it can be shown *intra vitam* by Janus green and neutral red. It is visible in fresh cells *intra vitam*, and can be photographed. It stains heavily in the Lewis Janus green-iodine vapour method. The Golgi rods or batonettes are rigid bodies, which retain their shape when released from the cell. Neither the Lewis Janus green-iodine vapour method nor Janus green alone are specific for the mitochondria.—V. **Nath**: Cell inclusions in the oogenesis of scorpions. In forms the oocytes of which contain vitelline yolk there is copious discharge of nucleolar material preceding yolk formation. In other forms the nucleolus remains quite inactive. The Golgi elements in Palamnæus swell up enormously after fragmentation and give rise to yolk (Golgi yolk), which contains free fat like the Golgi yolk of Lithobius (Nath) and *Helix aspersa* (Brambell). The Golgi elements of Euscorpius and Buthus also swell up and form Golgi yolk which, however, retains the same chemical constitution as the Golgi elements. In the centrifuged oocytes of Euscorpius the vitelline yolk is thrown down and the Golgi yolk tends to go towards the opposite pole. The central area is occupied by the granular mitochondria, the unchanged Golgi elements and the nucleus. The mitochondria in all the forms studied are granular and do not take any part in vitellogenesis. Although there is a remarkable disparity, paralleled only in *Paludina vivipara*, in size of the granular mitachondria of oocytes, on one hand, and the very prominent, hollow, vesicular mitochondria of spermatocytes on the other, the vesicular type is only a phase in spermatogenesis.—L. J. **Harris**: The combination of proteins, amino-acids, etc., with acids and alkalis and their combining weights, as determined by physico-chemical measurements.

Physical Society, January 23.—W. **Clack**: An investigation into corrections involved in the measurement of small differences in refractive index of dispersive media by means of the Rayleigh interferometer, with special reference to the application of the results to measurements in diffusion.—B. J. **Taylor** and W. **Clarkson**: A study of the production of "flashing" in air electric discharge tubes. The volt-ampere characteristics for the air discharge tubes is of the general form, $i=k(V-M)$. As in the case of the

"osglim" lamp, there is a critical resistance R_0 below which no "flashing" is possible, given by $R_0 = E - V_B/\{k(V_B - V_A)\}$ —C R **Darling** A kinematographic study of the formation of Plateau's spherule Orthotoluidine is allowed to flow slowly into the bulb of an inverted thistle funnel supported mouth downwards in water; when a sufficient body of the liquid has collected, a large drop is formed which gradually changes shape until it breaks away, leaving behind a small secondary droplet known as "Plateau's spherule" Kinematographic study of the breaking process shows that the main drop remains approximately spherical, the liquid to which it is attached extending downwards in a sharply pointed cone attached to the main drop at its point After breaking away, the main drop falls, oscillating considerably in shape The rest of the liquid snaps back to form a more or less spherical surface, but the point of the cone is left behind to form the droplet referred to; this is given a slight upward impulse before it also falls to the bottom of the water

PARIS

Academy of Sciences, December 29 —Ch **Lallemand** Concerning the tetrahedral system Lowthian Green in 1875 suggested that a hollow sphere, submitted to an external pressure, should take a form derived from the tetrahedron In a recent note Lecornu shows that this view is not supported by a mathematical investigation Experiments by the author, in 1887, on rubber balloons, and by Ghesquière and de Joly, in 1895, on glass globes softened by heat, are in accord with the tetrahedral theory —Marcel **Brillouin** The equations of state of the plastic phase of a solid naturally isotropic —Gabriel **Bertrand** and M **Mokragnatz** The general presence of nickel and cobalt in arable earth. In an earlier communication, the presence of traces of nickel and cobalt in two samples of soil was proved The analytical method has now been improved, and results of analyses of thirty-three soils from different localities (France, Germany, Denmark, Italy, Roumania) are given. The amounts found, expressed in parts per million of earth, vary between 38·6 and 4 7 for nickel and 11 7 and 0 3 for cobalt There is always less cobalt than nickel Dust from interplanetary space is suggested as a possible source of these two metals in arable earth —André **Blondel** Certain coefficients of self-induction of alternators —V. **Grignard** and J **Savard** The enolic form of pulegone —C **Sauvageau** Some examples of *hétéroblastie* in the development of some Algæ (Castagnea) —R H **Germay** —The integration by successive approximations of systems of partial differential equations of the first order —Fritz **Carlson** Integral functions —S **Stoilow** An ensemble where a continued function has a constant value —Antoine **Lomnicki** Some generalisations of the arithmetical triangle of Pascal —L. **Escande** and M **Ricaud** Some methods of measuring velocities in hydraulics The chronophotographic method of measuring velocities, utilising fine powder in suspension, fails when the fluid is in a turbulent state The substitution of small spheres of density equal to that of the water for the powder gives good results for the mean local velocity The conditions under which the Pitot tube gives trustworthy measurements are discussed, and a modified method suitable for low velocities described.— —**Rateau** Remarks on the preceding communication —A. de **Gramont de Guiche** An acoustic indicator of relative velocity for an aeroplane —R **Biquard** and A. **Chenu** A method for the regeneration of the gas of a balloon, avoiding deflation —J **Guillaume** Observations of the sun, made at the Observatory of Lyons during the third quarter of 1924 Observations of the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude were made on 87 days during the quarter —A P **Rollet** An electrolytic frequency meter of simple construction The apparatus is based on the phenomena of successive oxidation and reduction shown by a silver electrode, when the electrolysis takes place in an alkaline solution with a low frequency alternating current —Albert **Nodon** Researches on X-rays of long wave-length —J H **Shaxby** The production of Laue diagrams by means of monochromatic X-rays, and the structure of mother-of-pearl The mineral part of mother-of-pearl consists of crystals of aragonite, the quasi-hexagonal axis of which is normal to the leaflets. —F **Croze** The structure of the line spectrum of nitrogen — —**Lespieau** The preparation of true acetylene compounds, starting with the mixed magnesium derivatives of acetylene —H **Colin** and Mlle A. **Chaudun** The hydrolysis constant of sugar The authors qualitatively confirm the results of Moran and Lewis, and find that the velocity of hydrolysis increases more rapidly than the concentration of the sugar, although quantitatively there is not exact agreement This increase in the velocity of hydrolysis with sugar concentration is shown to depend on the nature of the acid employed as the catalyst — —**Royer** The orientation of the crystals of ammonium iodide by muscovite —G **Mouret** The structure of the granitic region of Millevache —Maurice **Collignon**. The audition of explosion waves at great distances Deductions from the explosion experiments at Courtine in May 1924 —M **Coyecque** and Ph **Wehrlé** The formations of Hatteras —Paul **Guérin**: The development of the anther and pollen in gentians. —L **Léger** The nutritive value of the snail (*Helix pomatia*) In *Helix pomatia*, in the condition of winter sleep, upwards of 80 per cent of the fat, and all the glycogen and reducing sugars, are localised in the part usually rejected for food The snail should be eaten *in toto* —Alexandre **Lipschutz** An intersexual malformation in the guinea-pig —Léon **Blum**, Maurice **Delaville**, and van **Caulaert** Contribution to the study of the pathogeny of rickets The essential trouble in rickets is not due to an alteration of the mineral contents of the blood, but in modifications of their physico-chemical state, the latter resulting from an alteration of the acid-base equilibrium —Marcel **Duval** The ionic reaction of the blood of some invertebrates — —**Cluzet**, **Rochaix** and **Kofman** Variations in the agglutinating power of sera under the influence of the continuous electrical current —Maurice **Nicloux** New demonstrations of the normal presence of carbon monoxide in the blood. The presence of traces of carbon monoxide in normal blood has been disputed from the results of experiments described by the author, the presence of this gas in normal blood is proved —A **Malaquin** The genital glands and primordial sexual cells in the annelid *Salmacina Dysteri* —Mlle **Goldsmith** Light and the symbiotic relations in *Convoluta roscoffensis* —Constantin **Gorini** The mammary coccus —A **Borrel** and Mlle **Muller**· Vaccinal virus in the cornea of the rabbit

January 5 —L **Lecornu**: The tetrahedral deformation Remarks on the experiments of M Lallemand —W **Kilian** and G **Sayn**. The external edge of the subalpine chains to the east of Valence (Drôme) and the breccia of Pialoux —Paul **Vuillemin** The *Nématés*, a new division of the animal kingdom —Jean **Effront**· The absorbing power of agar-agar Extraction with acid reduces the mineral content of agar-agar, and this demineralised agar does not absorb acid Pulps from plants, such as beetroot and potato, behave in a similar manner — — **Angelesco** Certain systems of

biorthogonal functions —A **Bloch** On a circle where a holomorph function takes at least twice the values 0 and 1 —S **Saks** A class of interval functions —J **Haag** The experimental determination of the parameter of precision —A **Talon** The piezometric equivalence of the yield of transmission —W W **Heinrich** New classes of secular solutions of the problem of *n* bodies —L **d'Azambuja** Observations of mobile masses of absorbing vapour at great heights above the solar surface Comparison with high protuberances of rapid evolution —Albert **Pérard** The refractive index of air, in the visible spectrum, between 0° and 100° C The apparatus used was that of Benoit, slightly modified The final result is given by the equation

$$(N-1)10^6 = \left(288\ 02+\frac{1\ 482}{\lambda^2}+\frac{0\ 0309}{\lambda^4}\right)\left(\frac{h}{760}\right)\left(\frac{1}{1+0\ 003716\,\theta}\right),$$

where λ is the wave-length in microns, θ the temperature in centigrade degrees —Y **Rocard** The diffusion of light in fluids —Mlle M **Hanot** The width of the lines of the Balmer series in the oscillating discharge For a given initial temperature and pressure, the maximum intensity of the current which traverses a slightly damped oscillating spark determines the width of the lines studied —— **Bayen** The spark spectra of tungsten and mercury in the extreme ultra-violet —R **Jouaust** and P **Waguet** The use of the photo-electric cell for certain measurements in industrial photometry In photometric measurements it is not, in general, possible to replace eye observations by a photo-electric cell, but in certain cases it is possible One possible application of the cell is the preparation of standard electric lamps, and a description of the method used and precautions necessary is given —J **Valentin** and G **Chaudron** The solidification of the ternary alloys of aluminium, magnesium, and cadmium —Edouard **Urbain** The absorption of vapours by carbon Defining the "compacity" of carbon as the ratio of the true volume to the apparent volume, absorption curves are given showing the amount of vapours of chlorine, chloropicrin, and benzene absorbed as a function of the compacity In the case of benzene there is a maximum absorption for compacity 0 3 —Pierre **Auger** The secondary β-rays produced in a gas by X-rays —L **Hackspill** and R **Grandadam** The displacement of the alkali metals by iron At a moderately high temperature, in a vacuum, iron sets free the metals of the alkalies from their hydroxides, in some cases it is possible to collect the alkali metal, in others the presence of the metal can only be proved by the evolution of hydrogen in contact with steam —Al **Orékhoff** and Max **Roger** The semipinacolic deamination of some amino-alcohols Amino-alcohols of the type R R′ C(OH) $CH_2(NH_2)$, treated with nitrous acid, give the ketones R CO CH_2 R′ —Max and Michel **Polonovski** Oxyeserine and its derivatives —Marcel **Sommelet** Researches in the diphenylmethene series Trimethylbenzhydryl-ammonium bromide —J **Grosjean** and M **Dosios** The horizon of the Posidonomyes schists containing hydrocarbons of the Toarcian of the Franche-Comté Jura Analyses of four schists are given, showing yields of oil Separate analyses of the oils are appended —E G **Mariolopoulos** The rains sometimes observed with anticyclones —René **Fabre** The nature and variations of the aldehyde contained in the blood There exists in the blood a volatile reducing substance possessing the characters of acetaldehyde —G **Mouriquand**, A **Leulier** and P. **Michel** Fluctuations of the iron in blood in the course of experimental scurvy.

Official Publications Received.

Anales del Museo Nacional de Historia Natural de Buenos Aires Tome 31 Pp iv+678 (Buenos Aires)

The Journal of the Institute of Metals Vol 32 Edited by G Shaw Scott Pp xii+820+37 plates (London 36 Victoria Street, S W 1) 31s 6d net

University of California Publications in American Archæology and Ethnology. Vol 21, No 3 The Uhle Pottery Collections from Ica By A L Kroeber and William Duncan Strong With three Appendices by Max Uhle Pp 95-133+plates 25 40 (Berkeley University of California Press) 85 cents

Crichton Royal Institution, Dumfries Eighty fifth Annual Report, for the Year 1924 Pp 45 (Dumfries)

Union of South Africa Department of Agriculture (Division of Chemistry Series No 51) Science Bulletin No 35 Profitable Potato Production, Results of a Bethal Co operative Experiment By Thos D Hall Pp 14 (Pretoria Government Printing and Stationery Office)

Annals of the Natal Museum Edited by Dr Ernest Warren Vol 5, Part 2, January Pp 101 234+plates 8-14 (London Adlard and Son and West Newman, Ltd) 15s net

Proceedings of the American Academy of Arts and Sciences Vol 59, No 16, December The Bodily Proportions of Women in the United States, based upon Measurements taken from one hundred Smith College Students By Dr Harris Hawthorne Wilder and Margaret Washington Pfeiffer Pp 439 603 (Boston, Mass) 4 25 dollars

The Journal of the Royal Horticultural Society Edited by F J Chittenden Vol 50, Part 1, January Pp 172+lxxvii (London Vincent Square, S W 1) 7s 6d

Royal Horticultural Society Notices and Arrangements for the Year 1925, Report for the Year 1924, with Statement of Accounts, List of new Fellows, Horticultural Advertisements Pp 167+lxxvii (London Vincent Square, S W 1)

Carnegie Institution of Washington Annual Report of the Director of the Department of Terrestrial Magnetism (Extracted from Year Book No 23, for the Year 1924) Pp 145-186 (Washington)

Proceedings of the Edinburgh Mathematical Society Edited by Dr Archibald Milne and Dr T M Macrobert Vol 42 (session 1923-24), Part 2 Pp 61-112+viii (London G Bell and Sons, Ltd)

Annals of the (Mededelingen van het) Transvaal Museum Vol 11, Part 1 The Sphegidæ of South Africa By Dr George Arnold Part 5 On Cynodontia from the Middle Beaufort Beds of Harrismith, Orange Free State, On a new Type of Thecodont from the Middle Beaufort Beds By Dr S H Haughton Pp 97+8 plates (Cambridge Printed at the University Press)

Armstrong College, Newcastle-on-Tyne Standing Committee for Research First Annual Report, 1923-4 Pp 12 (Newcastle-on-Tyne)

Proceedings of the Society for Psychical Research Part 92, Vol 34, December Pp 201-341 (London Francis Edwards) 9s net

Diary of Societies.

SATURDAY, FEBRUARY 14

ROYAL INSTITUTION, at 3 —W Rothenstein The Artist's Relation to Social and Religious Life (I)

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 —Sir D'Arcy Power Hunterian Oration

INSTITUTION OF STRUCTURAL ENGINEERS (Western Counties Branch) (at Royal Institution, Swansea), at 6 —G B R Pimm Piles and Pile Foundations

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at Municipal College of Technology, Manchester), at 7 —W H Meadowcroft Some Foundry Experiences

INSTITUTION OF AUTOMOBILE ENGINEERS (at Loughborough Technical College), at 7 30 —Loughborough Graduates' Meeting

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers), at 7 30 —V C Faulkner Some Notes on Refractory Materials

MONDAY, FEBRUARY 16

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —C P G Wakeley The Etiology, Pathology, and Treatment of Ectopic and Imperfect Descent of the Testis

ROYAL SOCIETY OF MEDICINE, at 5 30 —Dr L Williams, Col R McCarrison, Dr W Cramer, Dr G M Findlay, and others Special Discussion on Non-Specific Disturbances of Health due to Vitamin Deficiency

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7 —F G Woollard. British Methods of Continuous Production

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St. Mary's Parsonage, Manchester), at 7 15 —A D Young The Design and Construction of the No 5 Gas Holder for Burnley Corporation

INSTITUTION OF AUTOMOBILE ENGINEERS (Scotland Centre) (at Royal Technical College, Glasgow), at 7 30 —C H Macmillan Marine Motor Installation

BRITISH ASSOCIATION OF CHEMISTS (Birmingham Section) (in Medical Theatre, Birmingham University), at 7 45 —Dr F W Aston Atomic Weights and Isotopes

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —D S McColl Sculpture in relation to Architecture

ARISTOTELIAN SOCIETY (at University of London Club), at 8 —Dr. J. Drever The Meaning of Consciousness for the Psychologist

ROYAL SOCIETY OF ARTS, at 8 —Dr W. Rosenhain The Inner Structure of Alloys (Cantor Lectures) (I)

FARADAY SOCIETY (at Chemical Society), at 8 —Prof A. J Allmand and V S Puri The Effect of Superposed Alternating Current on the Anodic Solution of Gold in Hydrochloric Acid —Prof C H Desch and

Eileen Vellan The Electrolytic Deposition of Cadmium and other Metals on Aluminium —W M Thornton and J A Harle The Electrolytic Corrosion on Ferrous Metals —S Glasstone Overvoltage and Surface Forces at the Lead Cathode —M Shikata The Electrolysis of Nitrobenzene with the Mercury-dropping Cathode —J R Coutts The Law of Distribution of Particles in Colloidal Suspensions A Note on the Specific Volume of a Gamboge Suspension —W W Barkas The Distribution of Particles in Colloidal Suspensions

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 8 45 —Prof D M S. Watson Orthogenesis

MEDICAL SOCIETY OF LONDON, at 9 —Sir Bernard Spilsbury Wounds and other Injuries (Lettsomian Lectures) (I)

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court)

TUESDAY, FEBRUARY 17

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof J Barcroft The Colour of the Animal Creation (II) The Colour of the Hare

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 —E J Russell and T Edser The Fishery Statistics of England and Wales

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Secretary Report on the Additions made to the Society's Menagerie during the month of January 1925 —Major S S Flower Contributions to our Knowledge of the Duration of Life in Vertebrate Animals—I Fishes, II Batrachians —R I Pocock. (a) The External Characters of an American Badger (*Taxidea taxus*) and an American Mink (*Mustela vison*) recently exhibited in the Society's Gardens, (b) Additional Notes on the External Characters of some Platyrhine Monkeys —Dr R Broom The Origin of Lizards —A. Loveridge *Natrix olivacea* Peters (Reptilia), from Pemba Island, and other Notes —E P Allis, jun The Origin of the V-shaped Branchial Arch in the Teleostomi

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7 —H W Clothier The Design of Electrical Plant, Control Gear, and Connexions for Protection against Shock, Fire, and Faults

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7 —C F Elwell The De Forest Phonofilms

INSTITUTE OF CHEMISTRY AND SOCIETY OF CHEMICAL INDUSTRY (at 36 York Place, Edinburgh), at 7 30 —T Bolam, W O Kermack, W T H Williamson, and others Discussion on The Stability of Colloids

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Freemasons' Hall, Edinburgh), at 7 45 —Prof G W O Howe World-wide Radio Telegraphy (Faraday Lecture)

HULL CHEMICAL AND ENGINEERING SOCIETY (at Grey Street, Hull), at 7 45 —R A Bellwood The Romance of the Vegetable Oils

WEDNESDAY, FEBRUARY 18.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2 30

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Dr G Scott Williamson The Anatomy and Physiology of the Thyroid Apparatus (I)

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with the Liverpool Geological Society) (in Chemistry Department, Liverpool University), at 6 —Prof P G H Boswell Mineral Oil Supplies of the Present and Future

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6 —R H Tangri Reconstruction of Barrow Haven Bridge, Lincolnshire, L and N E Ry

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —H W Clothier The Design of Electrical Plant, Control Gear, and Connexions for Protection against Shock, Fire, and Faults

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates' Meeting) (at Chamber of Commerce, Birmingham), at 7 30

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7 30 —Prof H V A. Briscoe and P L Robinson A Redetermination of the Atomic Weight of Boron

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub Centre) (at Royal Victoria Hotel, Sheffield), at 7 30 —W B Woodhouse Presidential Address

ROYAL METEOROLOGICAL SOCIETY, at 7 30 —Miss L Doris Sawyer The Effect of Pressure Distribution upon London's Sunshine in Winter —Prof S Chapman On the Changes of Temperature in the Lower Atmosphere, by Eddy Conduction and otherwise —N K Johnson and O F T Roberts The Measurement of the Lapse Rate by an Optical Method

ROYAL SOCIETY OF ARTS, at 8 —Dr. J S Owens Modern Atmospheric Conditions

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY —J. M Hill Primitive Medicine and Folk-lore of the Guiana Indians

THURSDAY, FEBRUARY 19.

MEDICO-PSYCHOLOGICAL ASSOCIATION (at Royal College of Physicians, Edinburgh), at 2 30.—Dr D Slight The Psycho-galvanic Reaction —Dr G Gibson The Boarding out System.—Dr W M McAlister Results of Treatment of General Paralysis by Malaria.

ROYAL SOCIETY, at 4 30 —Prof O W Richardson and A F A Young The Thermionic Work-Functions and Photoelectric Thresholds of the Alkali Metals —J H Brinkworth The Measurement of the Ratio of the Specific Heats using Small Volumes of Gas —F H Constable The Catalytic Action of Copper Parts VI and VII —V H Stott, Edith Irvine, and D Turner Viscosity Measurements of Glass —*To be read in title only* —W G Palmer and F H Constable The Catalytic Action of Copper. Part V —P A. M Dirac The Adiabatic Invariance of the Quantum Integrals —D L Watson The Thermal Decomposition of Derivatives of Oxalacetic Ester—A Unimolecular Reaction —K. R Rao (1) The Fluorescence and Channelled Absorption of Bismuth at High Temperatures, (2) A Note on the Absorption of the Green Line of Thallium Vapour

LINNEAN SOCIETY OF LONDON, at 5 —Miss A Lorrain Smith John Templeton's Drawings of Lichens and Fungi —Dr J. Burtt-Davy The Tropical African Element in the Arborescent Flora of the Transvaal —Prof. R R Gates Virescent Inflorescence of Delphinium

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg The Properties and Structure of Quartz (IV)

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5 30

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6 —F M Alexander An Unrecognised Principle in Human Behaviour

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —Major E I David Electricity in Mines

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 7 —Lt Col L F R Fell Light Aeroplane Engine Developments

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7 —W E Bush Modern Electric Lighting Practice

INSTITUTION OF AUTOMOBILE ENGINEERS (Derby Graduates' Meeting) (at Cavendish Café, Derby), at 7 30 —R Bolton The Early History of Road Transport

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 7 45 —Dr H Meleney Demonstration on the Pathology of Experimental Leishmaniasis in the Hampster —At 8 15 —Prof B Blacklock Schistosomiasis and Goitre in Sierra Leone

CHEMICAL SOCIETY, at 8

SOCIETY OF DYERS AND COLOURISTS (West Riding Section) —Prof E C C Baly Photosynthesis of Naturally Occurring Compounds

FRIDAY, FEBRUARY 20

GEOLOGICAL SOCIETY OF LONDON, at 3.—Annual General Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Dr G Scott Williamson The Anatomy and Physiology of the Thyroid Apparatus (II)

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6 —Discussion

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at City Council Chamber, Birmingham), at 7 —W B Woodhouse Presidential Address

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —A. C Banfield Photography by Artificial Light

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —J N Seddon Inverted Tooth Chain Drives

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof T H Pear Acquiring Muscular Skill

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester) —D A Glibbens Some Work done in the Chemical Department of the Shirley Institute

INSTITUTION OF ENGINEERING INSPECTORS —Major C E S Phillips The Radium Industry

SATURDAY, FEBRUARY 21

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —W Rothenstein The Artist's Relation to Social and Religious Life (II)

PHYSIOLOGICAL SOCIETY (at London School of Medicine for Women)

PUBLIC LECTURES.

SATURDAY, FEBRUARY 14

HORNIMAN MUSEUM (Forest Hill), at 3 30 —E Lovett Natural History in Folk lore

MONDAY, FEBRUARY 16

ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, at 5 —Sir William I de Courcy Wheeler Some Practical Considerations and Experiences in the Conservative Treatment of Fractures of the Pelvis and the Lower Extremity (I) (Succeeding Lectures on February 17, 18, 19)

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —Dr E B Behrens Organising an International Civil Service for Purposes of Industrial Research

UNIVERSITY OF LEEDS, at 5 15 —Dr H H Dale Anaphylaxis

MEDICAL SOCIETY OF LONDON, at 5 15 —Prof E W Hope International Hygiene (Chadwick Lecture)

BIRKBECK COLLEGE, at 5 30 —Dr G G Coulton Medieval Education (III) Spoken Latin in the Middle Ages

KING'S COLLEGE, at 5 30 —Prof A. E Jolliffe English Mathematics before Newton

TUESDAY, FEBRUARY 17

KING'S COLLEGE, at 5 30 —Miss Evelyn Underhill The Realism of the Mystics

UNIVERSITY COLLEGE, at 5 30 —Prof J E G de Montmorency The Significance of the Humanism of the Negro Races

GRESHAM COLLEGE, at 6 —Sir H Walford Davies Music. (Succeeding Lectures on February 18, 19, 20)

UNIVERSITY OF LEEDS, at 8 —Prof J H Priestley Moorland Plants

WEDNESDAY, FEBRUARY 18

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —J Thorp The Principles of Design as applied to Books and Printing

KING'S COLLEGE, at 5 30 —Baron A F Meyendorff Travels in the East A D 800-1200

UNIVERSITY COLLEGE, at 5 30 —A. Gomme Technical and Scientific Libraries

THURSDAY, FEBRUARY 19

KING'S COLLEGE, at 5 30 —Dr I P Bruce Education in China

CENTRAL LIBRARY, 598 Fulham Road, at 8 —A. J Linford England's Story in Stone

SATURDAY, FEBRUARY 21

HORNIMAN MUSEUM (Forest Hill), at 3 30 —F Balfour Browne My Journey to Brazil

NATURE

SATURDAY, FEBRUARY 21, 1925.

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Editorial and Publishing Offices
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Words, Meanings, and Styles.

I.

FOR several weeks various opinions have been expressed in our correspondence columns as to the desirability or otherwise of using the word scientist to designate in a generic sense any one actively engaged in the advancement of natural knowledge by investigation. The term is not an Americanism, as is often supposed, but was introduced by Dr. Whewell in 1840 "to describe a cultivator of science in general." In a letter published in NATURE of November 29, Dr. Norman Campbell pleaded for approval of the word, and asked objectors to suggest a single substitute for it if they were not willing to adopt it. We invited opinions upon the question from a number of distinguished representatives of letters as well as of science, and have published some of the replies with which they have favoured us. The general attitude of scientific workers was clearly stated by Sir Ray Lankester in our issue of December 6, and it is one of dislike. Literary authorities, on the other hand, are prepared to give the word a legitimate place in the English language, and they point to many similar hybrids which have been admitted into our vocabulary without question.

It cannot be said that, as the result of the discussion, any single word has been suggested which is likely to come into general use as a substitute for scientist. Some of our correspondents have expressed complete abhorrence of this term, others have given unwilling acceptance to it, and a third group approves of it. While, therefore, we do not propose to depart from our custom of avoiding the word in our own practice, or in unsigned contributions for which we accept editorial responsibility, we are content to leave individual authors to use it or not, as they may prefer. Our opinion is that one of the main objections to the word is that it is too comprehensive in its meaning. Sir Israel Gollancz thinks the word should not be limited to workers in the field of physical or biological science, and Prof. Wildon Carr would make it imply philosophers as well as such workers. What they apparently desire is a word which is equivalent to the French savant or the German Gelehrte, but it can scarcely be said that the term scientist was coined with this intention.

The fact is that, in these days of specialised scientific investigation, no one presumes to be "a cultivator of science in general." A man is a chemist, physicist, biologist, botanist, or worker in one or more particular branches of science, and he prefers to be designated as such rather than to be placed in an indefinite group of "scientists." In an artificial language like Esperanto, it is easy to assign a single termination, such as "ist," to all professional occupations, but no hard and fast rule of this kind can be imposed upon the structure

of a living language. Certain words come into use, while others are discarded, and no purely logical or etymological plan of formation is practicable "Mathist" and "electrist" may, as Sir Richard Paget suggests, be improvements upon "mathematician" and "electrician," and Prof Armstrong's "sciencer" may be a suitable substitute for the word "scientist," but whether the termination be "ist" or "er," custom alone will decide which will survive We have geographer and geologist, engineer and technologist, philosopher and physicist, astronomer and spectroscopist, all in common use, whether rightly or wrongly formed The public has similarly accepted "scientist" to signify a follower of science of any kind, and will continue to use it even though it is not approved as good currency in the scientific world

An inquiry of the secretaries of the leading British scientific societies shows that the word is very rarely used in their publications and is always avoided when it can be conveniently avoided It is not used officially by the Royal Society of London or of Edinburgh, the British Association, or the Royal Institution, and each of these bodies often has occasion to refer to workers in science as a whole. The feeling of the Cambridge University Press is strongly against the use of the word scientist, and when, in one instance, it occurred in the title of a work submitted to the Syndics, a strong protest was raised and the title of the book was altered. On the other hand, the Clarendon Press, Oxford, does not object to the word being used in its books, and says: "Of course we avoid any attempt to legislate and are guided principally by usage." There is no doubt whatever that the balance of feeling in scientific circles is against the word. Whatever its future, therefore, we are not prepared to depart from our practice hitherto of avoiding the word, and we leave it to others to convert it into the currency of cultured usage

The variety of opinion on the recognition of the word scientist enables a conception to be formed of the labour involved in providing a good technical vocabulary for a new subject such as aeronautics. There is, first of all, the difficulty of setting up a systematic nomenclature with reasonable claims to be logical without being pedantic. In addition, there is the still greater difficulty of obtaining general acceptance by such diverse people as mathematical physicists, technical engineers, constructors, pilots, mechanics, the Services, and last, adoption by the press, most influential of all The Technical Terms Committee of the Royal Aeronautical Society, which was reconstituted in 1920 as a section of the British Engineering Standards Association, produced the present officially accepted glossary for aeronautics; and the Advisory Committee for Aeronautics in the U S.A has shown much broad-mindedness in adopting the great majority of the British findings There are important exceptions, however Dr Alexander McAdie, director of the Harvard meteorological station at Blue Hill, in writing to us about the word scientist comments on the continued use of the form "aeroplane" in Great Britain, replaced by "airplane" in America

Generally speaking, it will be found that, in the official glossary for aeronautics, *air-* is compounded with common English words, or with words derived through the French language, while *aero-* is compounded with technical terms of direct Latin or Greek origin Thus: *Air- man, ship, craft, shed, screw,* but *aero- stat, naut, bate, dynamics,* etc *Aerofoil* is an exception and should be either *airfoil* or *aerofolium* *Aeroplane* is right by the rule, but *seaplane,* introduced by the Admiralty during Mr. Churchill's regime, and *landplane, floatplane, wheelplane* proposed but not yet accepted, all justify *airplane* *Airplain* is ruled out by the lack of association of *plain* with wing-like structures; but the influence of the French word *aéroplane,* the interest vested in the title of our own liveliest of technical periodicals, and ingrained use, will prevent the giving up of the form *aeroplane* for a long time A very stout battle has been fought over the introduction of *air-screw* to avoid such combinations as *tractor propeller* and *pusher propeller* which are retained in the U.S A. vocabulary. The most awkward gap in the language of aeronautics is due to the want of words to denote aircraft both lighter than air and heavier than air. *Aerodyne* was proposed by analogy with *aerostat,* but nothing more has been heard of it, *H/A craft* and *L/A craft* beg the question, and it may be hoped that *lighter-than-air-craft* will not survive. In the face of these few examples of the difficulties which crop up in a technical vocabulary, it is a bold prophet who will predict the terms around which the language will finally crystallise

In discussing the use or disuse in English of any particular word, the very mixed origin of our language must, of course, be borne in mind. Anglo-Saxon, Latin and Greek have all provided roots which appear in words in general use, while, if the vocabularies of the sciences and arts are taken into consideration, it is clear that a much wider range of languages has also been used This may perhaps account for the ease with which foreign words are introduced, often as slang at first, and eventually adopted, with little if any change in spelling It should also incline us to be tolerant of hybrid words, though, of course, the making of new hybrids, unlike the work of the plant-breeder, cannot be expected to be productive of beauty and increased usefulness, and should be discouraged

The question is discussed in an interesting article

by Mr George H Bonner in the December issue of the *Nineteenth Century* The real point is this: A word having crept into use, what is to be the ultimate authority for discarding or retaining that word as a definite part of the English language? In France the decision is in the hands of the Academy A word is "adopted" or otherwise and the writers of the day follow, more or less, the recommendations made But that will not prevent the use of a word in conversation and by the general public After all, it is the growth of popularity of a word which is a factor in bringing it to the notice of the Academy. If a new word is useful in that it conveys an exact meaning not readily expressed in a word or concise phrase at present accepted as legitimate, it would seem that popular usage will gradually enforce its adoption Thus the vocabulary of a language, if it is to meet the demands made upon it by a progressive people, must be continuously in a state of flux

This may explain, in part, why so little progress has been made in the adoption of an international language. Apart from the claims of nationalism, which have been increasingly insistent during the past few years, "living" languages must, with the growth of new ideas and the introduction of foreign elements, be always developing It therefore becomes difficult for those who are not, as it were, "living with the language," to keep pace with changes of meaning. As regard purely artificial languages, the question of following the dictates of an academic central authority again arises The authority, in most cases, will trail behind popular usage.

There is, however, a further consideration, as Mr. Bonner points out in the article to which we have referred The language of conversation is not normally the language of serious writing In talking, the periods are generally comparatively short and the argument often gains by the use of terse and incisive expressions which would be totally out of place in written contributions When it is a question of placing on record, for serious discussion and reflection, facts and thoughts which represent additions to the sum of human knowledge, then accuracy of meaning and dignity of expression should be the rule. Here again, in English, popular usage would seem to be the ultimate authority, though with the restriction that "popular usage" should refer to the diction and style of the better educated and more intellectual of the community. The language of a progressive people must itself be progressive, and as the word scientist expresses more clearly and with less ambiguity than any other single word the meaning it is intended to convey, it is likely to survive the dislike which scientific workers in general have for it.

Continental Drift.

The Origin of Continents and Oceans By Prof. Alfred Wegener. Translated from the third German edition by J G A Skerl Pp xx+212 (London: Methuen and Co, Ltd, 1924) 10*s* 6*d* net

THE wide appeal of Prof Wegener's theory of the arrangement of ocean and continent is shown by the issue of a third greatly revised edition and of this excellent English translation His theory is that the continents consist of rigid blocks of sial, or rock characterised by a high percentage of silica and alumina, which are floating partly submerged in a sheet of sima, or rock material composed mainly of silica and magnesia; that the existing continents are due to the breaking up of a once continuous sheet of sial, the fragments of which have drifted to their present positions in consequence of the earth's rotation, and that this drift occurs owing to the plasticity of the sima Prof. Wegener believes that the continents have been moved for great distances even in geologically recent times, and he thereby, with great ingenuity and attractiveness, explains many problems of geography, geology, climatology, biology, and geodetics The process offers an easy escape from difficulties and is not to be dismissed as impossible or scouted as fantastic, for in all probability sima is more plastic than sial, and the rotation of the world must make the continental masses tend to lag westward, and press centrifugally toward the equator The view that the continental masses are subject to some horizontal drift has been often adopted, as, for example, by the reviewer in 1915 (*Scot. Geog. Mag*, 31, pp 258-60) to explain the folded nature of the Pacific margin of America, in contrast to the coastal structure on both sides of the Atlantic, and the prevalence of fiords on western coasts. There is no *a priori* objection to the principle, and the verdict on Prof. Wegener's theory will depend on whether it explains more difficulties than it creates

The author's interesting discussion of the geophysical arguments shows that on this branch of the subject the primary facts are still uncertain In spite of the apparent precision of mathematical methods, the data are so inexact that the results are inconclusive Prof. Wegener's theory will, however, probably give a new lease of life to the explanation of the Carboniferous glaciation of India and of some parts of the Southern Hemisphere, by the shifting of the Pole; for arguments, which are unanswerable against that explanation with scattered continents, do not apply to Prof. Wegener's single continent

The theory of continental drift was suggested by that coincidence in course of the opposite coasts of the

Atlantic, which is one of the best known of the geographical homologies Its significance was remarked by Bacon. Prof Wegener has the advantage over Lord Bacon that the geological evidence now supports the inferences from geographical shape, for the opposite parts of the Atlantic show remarkable resemblances in structure and composition The agreements, according to Wegener, are due to the coasts having been originally in contact, and having been separated by a curved fracture which was widened into the Atlantic basin, owing to the land west of the rift having drifted away as America The agreement in grain of the lands on the two sides of the Atlantic is, however, also capable of explanation by vertical movements of the crust If two pieces of wood with the grain of each in line are seen in a sheet of water, it does not follow that they were originally in contact and have floated apart They may be the ends of a warped plank, of which the middle has sunk beneath the surface The Appalachian and Armorican Mountains may have belonged to a continuous mountain belt without their having been actually adjacent, just as the Pyrenees and the Caucasus are regarded as part of one mountain system although they have always been separated by the full width of Europe In fact, the differences between the Appalachians and the corresponding mountains in Western Europe indicate that they were probably formed some distance apart The problem is whether the corresponding structures on opposite sides of the Atlantic have been separated by a two-mile subsidence of the intervening area, or by the horizontal drift of America for 2000 or 3000 miles.

Individual judgments on this question depend upon the theory accepted of the structure of the earth; and long before any agreement is reached by this route, the displacement theory should be proved or dismissed by direct observation According to Prof Wegener, southern Greenland is moving away from Scotland at the rate of from 18 to 36 metres a year, and Iceland is drifting away from Norway from 18 to 19 metres a year The estimate for Greenland rests on the difference of longitudes determined by the *Germania* expedition of 1870 and the Danish expedition of 1907, they were determined by lunars and are not convincing Wireless determinations of longitude at intervals of five or ten years should soon provide an absolute test of the theory, as is remarked by Dr Evans in his interesting introduction to the volume.

The movement in the central Atlantic is regarded as slower than in the north, yet as increasing the distance between Brazil and the Cameroons eight inches a year The growth of the tropical Atlantic, according to Prof Wegener's table, has taken about 20 million years, though at the rate of drift assigned to Brazil, the time should have been 40 million years, therefore, according to the geological dates accepted on p. 113, the formation of the tropical Atlantic began in the early Mesozoic The westward drift of South America is regarded as a long-continued process, and its crumpling effect on South America should have been widespread and continuous The folding of the Andean belt was intermittent and happened at distant dates, but the folding that made the existing Andes happened in a relatively short period That condition is consistent with the explanation of the Andean folding by a western lag which has been previously referred to, as the lag was attributed to instability due to vertical movements in the crust at one geological period, but without some acceleration of the westward movement in the middle Kainozoic, Wegener's continental drift does not explain the formation of the western fold mountains of America. Moreover, as the author shows in the fifth chapter from the palæontological evidence, the land connexion across the Atlantic was established and broken several times, so the displacement theory requires a concertina-like movement, America being pushed first west and then east A vertical oscillation of the crust presents no difficulty comparable to that of an oscillatory horizontal passage of the Americas to and fro across the Atlantic

A horizontal oscillation of even that amount is, however, insufficient. The displacement hypothesis is advocated from biogeography on, amongst other grounds, the occurrence on both sides of the Atlantic of animals and plants which apparently crossed it in about their present latitudes, and that shallow water marine animals, to which the deep seas are almost as impassable as to land animals, show the former range of shallow water along the same zones The argument based on the marine animals appeals to the reviewer as one of his earliest papers urged it from the evidence of the fossil Echinoidea Prof Wegener quotes the manatee, which lives in the estuaries of West Africa and South America and is not likely to have crossed an ocean so wide as the Atlantic There is, however, similar evidence of land connexion across the Pacific The alligator is now found only in the Yangtze Kiang in China, and in the warmer parts of America; and it is no more likely to have crossed the open ocean or rounded the Pacific by Bering Straits than the manatee is to have crossed the Atlantic via Iceland and Greenland Some lizards, amphibians, and the main flora of China support the evidence of the alligator as to a former land route across the Pacific to America. It is, however, essential to Prof Wegener's case that Western America and the eastern lands of the Old World should have been previously farther apart than they are to-day; for before the separation of the Americas from Europe

and Africa the Pacific must have been wider. Prof Wegener remarks (p 86) that some of the earthworms of Australasia and New Zealand not only reach India but also, "strange to say, occasionally the west coast of North America"

This range of Australasian worms to western America is one item in a mass of biological evidence inconsistent with the view that America has been drifting westward into the Pacific For example, Pritchardia, the characteristic palm of the south-western Pacific, is known elsewhere only in the Sandwich Islands and in Cuba, where its unexpected occurrence was attributed by Beccari to its fruits having been hurled from Polynesia by a volcanic eruption. According to Dr Scharff, one element in the flora of the islands off western Mexico represents the eastern range of a central Pacific flora which was partly of Australasian and Eastern origin Similarly, according to Pilsbury, the distribution of the land shells demands radial migration from a central Pacific land. Its existence is also indicated by the coral islands and by the contours of the Pacific floor

The existence of a land connexion from America westward across the Pacific is, however, wholly inconsistent with the present form of the displacement theory. If the pilgrims had been rafted across the Pacific on migrating lands, America, after its separation from the western side of the Old World, not only drifted westward until it bumped against eastern Asia, but also has floated back to its present position. Unluckily for this explanation, the trans-Pacific and trans-Atlantic connexions are required at about the same time Hence it would be necessary to assume that the sial mass of America at one time lost its rigidity and, like a rubber bladder, spread out as a thin sheet over both the Atlantic and Pacific basins; and that afterwards it contracted and thickened to form a meridional bolster. The original theory has undergone so many modifications, and its author is so delightfully open-minded, that it may be changed to agree with a trans-Pacific land connexion The theory at present is inconsistent with so many facts that Prof Wegener's calculation, that the odds based on the grain of the Atlantic shores are a million to one in his favour (p 56), do not hold for the whole of his case.

The favourable reception of Prof Wegener's theory is significant of marked changes of opinion as regards the structure and history of the earth. It shows that the once widely adopted view that oceans and continents have always been in their present positions no longer hampers geological interpretation, and it marks the growing belief in the effective mobility of the earth's crust

J W GREGORY.

Greek Alchemy.

Union Académique Internationale Catalogue des manuscrits alchimiques grecs. 1 Les *Parisini* Décrits par Henri Lebègue En Appendice, Les manuscrits des *Coeranides* et tables générales, par Marie Delcourt Pp x+320 n p 3: Les manuscrits des Îles Britanniques Décrits par Dorothea Waley Singer, avec la collaboration d'Annie Anderson et William J Anderson En appendice, Les recettes alchimiques de *Codex Holkhamicus*, éditées par Otto Lagercrantz Pp vii+84 n p (Bruxelles: Maurice Lamertin, 1924)

NO one who has not himself rummaged among the old chemical manuscripts in the great libraries can have any idea of the vast quantity of material which awaits investigation Even the printed literature of the fifteenth to seventeenth centuries has been by no means fully studied, but of the earlier manuscript material only a fraction has hitherto been examined This neglect is reflected in our histories of chemistry, which commonly begin seriously with Priestley and Lavoisier, by whose time chemistry was already well established on lines not widely different from those of to-day The earlier periods are usually dealt with very summarily, since to give an adequate account of them, in the present state of our knowledge, would entail years of laborious work upon the original sources The very ideas themselves, from their unfamiliar nature, often seem entirely unintelligible.

Any contributions, however small, to the accomplishment of the task presented to us by this unstudied material would therefore be certain of a warm welcome. When, however, they are of the standard and magnitude of the "Catalogue des manuscrits alchimiques grecs," it becomes difficult to express our thanks adequately For our knowledge of Greek alchemy we have had to rely practically entirely upon the work of Berthelot and his collaborator Ruelle, whose "Collection des anciens alchimistes grecs" (3 vols., Paris, 1888) has been almost the sole source of our information on this subject The recent revival of interest in the history of science has rendered it desirable to extend and amplify our knowledge of early chemistry, and it was very necessary to make a systematic investigation of all the extant manuscripts. Bibliographical research of this nature confers an inestimable boon upon later workers in the field, for it shows them at once what is and what is not available, and saves them more time than can readily be appreciated except by one who has suffered from the lack of such information.

That the present work is published under the direction of Profs. Bidez, Cumont, Heiberg, and Lagercrantz,

is a sufficient indication of its comprehensiveness and trustworthiness, two qualities which in an undertaking of this kind are absolutely indispensable Unless one can be perfectly certain that a bibliography is full and accurate, one always has the uneasy feeling that something of importance may have been overlooked, and there is nothing more depressing

Parts 1 and 3 of the Catalogue—all that are published so far—deal respectively with the Greek alchemical manuscripts in Paris and those of the British Isles The first part, which is the work of M Henri Lebègue, includes also a description of the MSS of the Koeranides by Mdlle M Delcourt, who provides, in addition, comprehensive indices to the whole volume On the Koeranides or Kiranides—a work on the virtues of plants and animals—reference may be made to Thorndike's "History of Magic and Experimental Science," 1923, ii ch. xlvi, and to Ruelle's "Lapidaires grecs," Paris, 1898 The Greek alchemical manuscripts at Paris are 19 in number. They are carefully described folio by folio, in such a way that a good idea is given of the whole contents When they have been edited, references are given to the edition Scholars, therefore, who desire information on the MSS will find, ready to hand, all that is necessary to enable them to form a judgment.

The third part, which deals with the manuscripts of the British Isles, is on similar lines. It includes also two papyri, one at the British Museum (Papyrus 121) and one in the Bodleian [MS. Gr f. 73 (p) 3396], a manuscript of the Koeranides, and the text of the Byzantine Greek manuscript on alchemy (290, ff 186-194) preserved in the library of the Earl of Leicester at Holkham Hall. The last section is the work of Prof. Otto Lagercrantz, the main portion of Part 3 was compiled by Mrs Singer, with the collaboration of Miss Annie Anderson and Mr. W J Anderson. Mrs Singer's catalogue of the scientific manuscripts of the British Isles now includes about 40,000 items, and the present catalogue is the development of one of the sections of the general catalogue. Those who have had the privilege of using the latter—a courtesy which Mrs Singer extends with unfailing generosity to all scholars—fully realise the tremendous assistance it will give to historical research in science, and will rejoice that this part of it is now in print

The general impression gained from a perusal of the two parts is one of astonishment at the comprehensiveness of Berthelot and Ruelle's work. As M Bidez says, "If the faults of Ruelle's work have become apparent, it is the result of a new scientific curiosity which he was one of the first to awaken" We cannot doubt that the publication of the present Catalogue will stimulate research into the origin of chemistry, it will certainly render the task of workers in this field very much easier. It is, moreover, not without interest to Hellenists themselves, for surely no student of Greece can afford to neglect this early scientific or quasi-scientific literature

The important Holkham Hall manuscript, which, at Sir Frederick Kenyon's request, the Earl of Leicester kindly allowed to be published, was brought to light by Prof. Cumont It has here been edited, with an introduction and critical annotations, by Prof Lagercrantz It is entitled "*τῆs ἀλτεμίας ἡ διαταξις καὶ ἡ συμβολὲς καὶ ἡ κόπροι*—alchimiae apparatio et compositiones et fimi"—and is interesting not only because of the strange substitution of *ἀλτεμία* for *ἀλχημία* or *ἀλχυμία* (a point which Prof. Lagercrantz discusses in his preface), but also because it shows that the Byzantines had original views on alchemy and did not confine themselves to reading and interpreting the works of the ancient Greek alchemists We hope that it may prove possible to publish a translation of this MS into English, French, or German, and so to make it more easily accessible

E. J HOLMYARD

Our Bookshelf.

Introduction to the Theory of Spectacles. By Prof. Dr. Otto Henker Translated by R Kanthack. Pp viii+336 (Jena School of Optics, London: J W Atha and Co, 1924) 13s 6d

THE book under notice follows the lines of Prof. Henker's courses of lectures on spectacles, the German edition from which the present translation by Mr. Kanthack is made was first published in 1921. Commencing from elementary principles, it gives an account of modern continental practice in spectacle optics, embodying the important work (in connexion with cataract lenses, telescopic spectacles, and other special aids to vision) of the Jena school under Prof Moritz von Rohr. This has been mainly accomplished since the year 1908 While the War with its immense number of special cases of injuries to the eye undoubtedly gave a renewed stimulus to studies of this kind, many sufferers are still (as Prof Cheshire points out in a foreword) ignorant of the aid which science can now give them The present book should fill a great need if it gives information of this kind

The mathematical theory goes no further than the usual Gaussian first-order treatment, but aberrational defects and means of overcoming them are explained with the aid of diagrams The analogy between the action of the anastigmatic spectacle lens (with its stop at the centre of rotation of the eyeball) and the single photographic landscape lens, in securing freedom from the astigmatism of oblique pencils, emphasises the fact, not yet sufficiently appreciated, that a spectacle lens must be designed with the same understanding and similarly thorough analytical and trigonometric methods as for any other optical instrument As

Gullstrand pointed out, such anastigmatism cannot be secured in high-power cataract lenses without the use of non-spherical surfaces The design of such lenses by Prof von Rohr and their production by Zeiss is one of the most interesting matters dealt with in the book The importance of this work to ophthalmological science cannot be too fully emphasised.

A number of terms and phrases are found which should not be adopted in Great Britain without question There are good reasons against the term "point-focal" as applied to any lens whatever, and there is no need to replace the familiar term "bending" (as applied to a lens) by "co-flexure." Other examples will be found

The number of tables and charts which the book contains render it in fact a very useful work of reference for the ophthalmologist, though it is undoubtedly more than an "introduction to the theory of spectacles", its scientific importance is unquestionable

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated "The Year Book of Photography and Amateurs' Guide" and "The Photographic Annual," 1925 Edited by George E Brown Sixty-fourth issue. Pp 816. (London H Greenwood and Co, Ltd, 1925) Paper, 2*s* net, cloth, 3*s* net

THIS almanac continues to occupy the unique position that its editor has earned for it, and to have lived down all its previous contemporaries Its general character is too well known to need description, and is maintained in the present volume, but a few welcome changes have been introduced The most notable of these is the replacement of the tables of chemical formulæ by a series of short articles dealing with the properties of the commonest of the chemical substances used in photographic processes These will be found of real practical utility, though they need a little revision One might, for example, be led into error by the statement that iodine is insoluble in water or by the representation of oxalic acid as if its crystals were anhydrous There does not seem any valid reason for calling ammonium, potassium, and sodium salts as ammonium, "potass," and soda salts respectively, and when uniformity means simplicity and offers no disadvantages, it is always desirable. The editor as usual contributes a long article, this year on "The Plain Facts of Lenses," which is eminently practical and easily understandable even by non-technical photographers There is also a second article by Mr T L. J. Bentley on how to get the best results with the very small cameras that are now in vogue. It appears that $3\frac{1}{4}$ in $\times 2\frac{1}{4}$ in is by far the most popular size as compared with either larger or smaller sizes of spools of roll-film.

Life and Science. By Prof. David Fraser Harris Pp. 204 (London Andrew Melrose, Ltd, 1923) 7*s* 6*d* net

THE author, in this little work, describes in simple terms the scientific aspect of certain vital phenomena Written in pleasant style, it appears suitable for the layman of an inquiring turn of mind, who wishes to know something of vital mechanisms without the need of a knowledge of physiology. The work opens with a chapter on the thesis that there is nothing new under the sun, and shows how man's inventions have been anticipated in the mechanisms found in his own body. After a chapter on mechanisms of defence, the author describes certain tissues which are characterised by possessing a rhythmic activity, thus leading up to a discussion of sleep, which is termed "life's great rhythm" stress is laid on the presence of fatigue products in the blood, a lessened blood supply to the brain, and a diminution in the number of sensory impressions reaching that organ In the following chapter examples of "latent life," taken from both the vegetable and animal kingdoms, are described. in the next, the rather uncommon subject of "coloured thinking" is dealt with, in these persons certain words or sounds are associated with certain colours, especially when a concept has to be visualised the condition occurs in perfectly normal people and has no relation to visual hallucinations The book closes with a plea for a greater recognition of the mutual influence of the mind and body upon each other, illustrated by the subject of faith-healing

Sunshine and Open Air: their Influence on Health, with special reference to the Alpine Climate By Leonard Hill. Pp vii+132+8 plates (London: E. Arnold and Co, 1924) 10*s* 6*d*. net

PROF LEONARD HILL has brought together in small compass a mass of valuable material bearing on the health-giving properties of sunshine and open air. He analyses the scientific facts which explain the curative effects of the Alpine climate, contrasting the composition and physiological effects of high and low atmospheres The value of this section is enhanced by a large series of comparative observations, not only on the hours of bright sunshine in numerous stations, but also by the exact measurement of the intensity of the sunlight and that of light reflected from the sky and the ground. These measurements are made both in terms of heat and of their biological action The chapter on the influence of moisture, mist, temperature is well worthy of careful consideration, as it offers explanations of the morbidity of the town dweller and the risks of infection run in confined sunless communities. In the chapter on the biological action of light, the author has summarised a large amount of valuable work done under his supervision in the Department of Applied Physiology in the National Institute for Medical Research. This work comprises the development of instruments for the precise measurement of actinic light both chemically and by its action on protozoa, the depth of penetration of various radiations, and their influence on the blood of animals and man The introductory chapter gives a practical account of the writer's personal experiences of the "sun cure," and the work is illustrated by some very clear half-tone reproductions.

The Chemistry of Crop Production By Prof. T. B. Wood. Second edition Pp. vii+193 (London: University Tutorial Press, Ltd, 1924.) 4*s*. 6*d*.

THE first edition of Prof T. B Wood's admirable little book on the scientific principles of crop production was reviewed in NATURE for March 24, 1921 (vol 107, p. 101). We are glad to note that a second edition has been called for, and that the publishers have found it possible to reduce the price from 5*s* 6*d* to 4*s* 6*d*. The text is unchanged, save that the examples are now based on prices current in 1924.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Solar Eclipse of January 24 and Wireless Signals.

DURING the solar eclipse of Saturday, January 24, the engineers of the Post Office and of the International Western Electric Company, at the instance of Admiral Sir Henry Jackson, measured the strength of wireless signals received from New York at Chedzoy in Somerset and at New Southgate, London. The results show that the signal strength rose to a sharp maximum and fell to a very sharp minimum during the progress of the eclipse.

At 14.12 G.M.T. totality occurred at New York and more than half of the trans-Atlantic track of the signals was in partial darkness; at this instant the strength of the signals received in England was observed to be about twenty per cent. above normal. At 14.52 first contact was visible in London, and by this time signals had increased to about double the normal strength. A few minutes later the centre of the total phase was in mid-Atlantic about 400 miles to the south of the wave track, and the whole of the track was now in partial darkness. The signal strength rose to a maximum first at Chedzoy and then at New Southgate. During the next half-hour the centre approached the wave track rapidly by moving in a north-easterly direction, and signal strength decreased greatly. At 15.30 the last contact occurred at New York, and at about 15.40 the signals received at both places of observation had fallen in strength to a minimum value less than one-fifth of the normal. At this instant about 300 miles of the western end of the wave track was in full daylight and the centre of the eclipse was crossing the wave track about 500 miles to the west of Ireland. By 15.45 the centre had moved beyond the Faroe Islands, daylight had returned, and at about 16.10 normal signal strength was regained. Throughout the eclipse directional measurements were made by the staff of the Radio Research Board, but no effect on bearings could be detected.

The occurrence of the maximum and minimum signal strengths on this occasion recalls the observations on the eclipse of Wednesday, April 17, 1912 (see NATURE, April 25, 1912, Vol. 89, p. 191). On that occasion, as there was no conveniently placed wireless station at work, the observations were made on "atmospherics" or "strays," which the meteorological conditions indicated were coming from Spain or North-west Africa. These earlier observations and also the new ones seem to be explained by the ionisation of the atmosphere by sunlight and the re-combination of the ions when the light is removed. This explanation was set forth in a paper read to the British Association in September 1912, as follows:—"My observations indicated that, firstly, when the penumbra stole over Western Europe and Western Africa propagation grew rapidly better; secondly, as the umbra itself crossed the Bay of Biscay towards France it began to hinder propagation, its interference being greatest after it had entered France near Les Sables, which means that at this moment it lay directly between London and the source of the strays; thirdly, that when the umbra passed on, the ionic medley it had created by re-combination of ions faded quickly" and propagation improved. The suggestion here is that the hurried and irregular re-combination of ions produced an ionic turmoil which obstructed electric waves. The obstruction arose, I suggested, not so much from absorption as from irregular refraction, the refraction being a consequence of the dependence of the velocity of electric waves through rarefied air upon the nature and concentration of the ions in it.

The interesting question now arises: What levels of the atmosphere are mainly concerned in these phenomena? Students of wireless telegraphy have long believed that there is an upper region in which free electrons exist more or less permanently and a middle atmosphere in which ions of molecular size are formed daily by sunlight. If I may quote again from my own writings: "Wireless investigators would suggest that the layer beneath the auroral layer is occupied by electrons that have come as beta-rays from the sun. The atmospheric pressure at above 50 kilometres is only about a millionth of an atmosphere; the mean free path of the electrons is therefore long and they may possibly remain permanently free in large numbers. It would seem that the base of this region charged with free electrons must be regarded as the ceiling usually known as the Heaviside layer." At night this ceiling reflects wireless waves of all lengths round the globe as a whispering gallery reflects sound. In the day the air below it is ionised, absorbs the waves in some degree, and gives to the rays a curvature which is greater as wave-length increases. To the Heaviside layer is attributed the "night effect" which afflicts direction finding. As no such effect was observed during the eclipse we may provisionally assume that the Heaviside layer did not come prominently into operation and that the middle heights of the atmosphere were responsible for the phenomena observed.

Sir Arthur Schuster, in his theory of the diurnal magnetic variations (Phil. Trans., A, 208, 1907, p. 182), requires that a portion of the upper atmosphere should possess a conductivity of 10^{-13} electromagnetic units in order to account for the usual variations. Prof. S. Chapman has of recent years elaborated this suggestion. But whether this portion of the atmosphere is above or below the Heaviside layer is not yet clear. It would seem that simultaneous observations of the effects of solar eclipses on the magnetic elements and on the propagation of signalling waves offers a means of solving this question.

W. H. ECCLES.

13 Catherine St., S.W. 1,
February 11.

Polarisation of Light from the Sky during the Solar Eclipse of January 24.

DURING the total eclipse on January 24, I was at New Haven, Connecticut, and thus very close to the middle line of the track of totality. For a portion of the period of totality I made a somewhat hasty survey of the state of polarisation of the light scattered by the sky, using for the purpose a Savart plate and Nicol prism. I was only able to cover the eastern sky from the zenith to the horizon stretching from north through east to south, and I was unfortunately not able to determine the plane of polarisation of the light scattered from the various parts of the sky. What I was able to note, however, with certainty was that there was no marked variation in the percentage of polarisation as one explored the eastward half of the sky—that is, there was no trace of the familiar maximum noted when the sun is not in eclipse.

As I am a physicist and not an astronomer I am not sufficiently familiar with the results of observations

of this sort at the time of previous eclipses to draw any conclusions from the fact I happened to note It may be worth recording, however, as the conditions at the time of the eclipse of January 24 were somewhat unusual in that the entire country surrounding the path of totality was deeply covered with newly fallen snow, and it seems possible that a very large percentage of the diffused sky light may have come by previous scattering from the extensive snow fields on either side of the track of totality, and relatively very little from either the corona or the direct light from the sun on the edge of totality

AUGUSTUS TROWBRIDGE

Relativity referred to a Flat Space-Time.

As a preliminary communication, I wish to indicate briefly a few main results which could be made the starting-point of a general theory of relativity which shall fit in, in a natural way, with the Newtonian scheme and older physics and shall avoid the necessity of formulating with Einstein a space-time continuum "curved" by the existence of matter It would be sufficient, as we shall show, to adopt a space-time continuum which is "flat," for the formulation of physical laws

Now let us write, in the usual form, the expression for the invariant interval between two contiguous point-events as

$$ds^2 = g_{\mu\nu} dx_\mu dx_\nu, \quad . \quad . \quad . \quad . \quad (1)$$

adopting Eddington's summation convention that whenever a literal suffix appears twice in a term, that term is to be summed for values of the suffixes 1, 2, 3, 4 The $g_{\mu\nu}$, of course, have to satisfy the necessary and sufficient condition for "flat" space-time, namely, the Riemann-Christoffel tensor

$$B^{\epsilon}_{\mu\nu\sigma} = 0 \quad . \quad . \quad . \quad (2)$$

Having thus defined the geometry we shall use, we shall show now how a consistent formulation is possible of the laws of mechanics, of gravitation, and of electro-magnetism, so as to conform to the general principle of relativity, still adhering to the fundamental concepts of "inertia" and of "force" and the invariability of mass, of the dynamics of Galileo and Newton.

Let us define the mechanical force acting on a mass-particle, by the tensor F^μ, as

$$mc^2\left\{\frac{d^2x_\mu}{ds^2} + \{\alpha\beta, \mu\}\frac{dx_\alpha}{ds}\frac{dx_\beta}{ds}\right\} = F^\mu, \quad . \quad . \quad (3)$$

where m is the mass of the particle, which is considered invariant, and c the velocity of light This tensor, together with its associated tensors, shall form the mechanical-force tensor

Now, on equating this tensor to zero, it easily follows that a mass-particle under no forces will describe a straight line in the space-time continuum, this, of course, corresponds to Newton's first law of motion, the law of inertia

Then, turning to gravitation, we shall have to define the mechanical force due to gravitation acting on a particle For this purpose let us define an invariant gravitation potential ϕ by the following tensor equation

$$g^{\mu\nu}\left(\frac{\partial^2\phi}{\partial x_\mu \partial x_\nu} - \{\mu\nu, \alpha\}\frac{\partial\phi}{\partial x_\alpha}\right) = \rho_0, \quad . \quad (4)$$

where ρ_0 is the proper-density of mass which can be expressed by the equation

$$\rho_0 = \rho\frac{ds}{dt}, \quad . \quad . \quad (5)$$

where ρ is the usual density.

Then the mechanical force due to gravitation may be defined by the tensor G^μ as

$$-m\left\{g^{\mu\alpha}\frac{\partial\phi}{\partial x_\alpha} - \frac{d\phi}{ds}\frac{dx_\mu}{ds}\right\} = G^\mu. \quad . \quad (6)$$

This tensor, together with its associated tensors, shall constitute the gravitational force tensor

Now let us see how the equations (3) and (6) reduce, under suitable conditions, to the equations of the Newtonian theory For this purpose we shall equate the expressions in (3) and (6) Then we have

$$mc^2\left\{\frac{d^2x_\mu}{ds^2} + \{\alpha\beta, \mu\}\frac{dx_\alpha}{ds}\frac{dx_\beta}{ds}\right\} = -m\left\{g^{\mu\alpha}\frac{\partial\phi}{\partial x_\alpha} - \frac{d\phi}{ds}\frac{dx_\mu}{ds}\right\}. \quad (7)$$

This, being a tensor equation, will hold for all co-ordinate systems if it holds for any Therefore let us take the Galilean system for which the line-element is

$$ds^2 = -dx_1^2 - dx_2^2 - dx_3^2 + dx_4^2 \quad . \quad (8)$$

Now, as the equations of the Newtonian theory hold only for velocities small compared with that of light, we have, if we introduce this restriction, approximately

$$ds = c\,dt$$

Then the equation (7) reduces, in the Galilean system, to

$$\left.\begin{aligned} m\frac{d^2x_\mu}{dt^2} &= m\frac{\partial\phi}{\partial x_\mu} + \frac{m}{c^2}\frac{d\phi}{dt}\frac{dx_\mu}{dt}_{(\mu=1,2,3)} \\ \frac{1}{c}\frac{d}{dt}(\tfrac{1}{2}mv^2) &= -\frac{m}{c}\frac{\partial\phi}{\partial t} + \frac{m}{c}\frac{d\phi}{dt}_{(\mu=4)} \end{aligned}\right\}, \quad . \quad (9)$$

where v is the velocity of the particle

Thus we see that if we identify ϕ with the Newtonian gravitation potential, the first equation of (9) gives the Newtonian equations of motion and the second equation of (9) leads to the equation of activity in a gravitational field Obviously we can identify ϕ with the Newtonian gravitational potential, for the equation (4) reduces for the Galilean system to the well-known form

$$\frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2} - \nabla^2\phi = \rho_0 \quad . \quad . \quad . \quad (10)$$

We have thus brought gravitational force under the general principle of relativity by expressing it consistently in the tensor form The second term of equation (6) is the essentially new feature of this theory, and it is curious to note that while it becomes insignificant in taking the space-components of the gravitational force tensor, it becomes quite significant in taking the time-component The fact that such a term has naturally to come in can be seen by multiplying both sides of the equation (7) by $g_{\rho\sigma}\frac{dx_\sigma}{ds}$ and contracting the product to an invariant, when both sides become zero It may also be seen that the choice of a gravitational force tensor seems to be limited as we have at our disposal only ϕ, $g_{\mu\nu}$, and $\frac{dx_\mu}{ds}$, and it does not seem to be possible to construct an alternative tensor degenerating to the Newtonian equations unless it be that G^μ of (6) is multiplied by an invariant differing little from unity. But there is no justification for doing this at present

There is also a striking resemblance between the second term of G^μ of (6), which we shall call the "velocity" term, and the electromagnetic force tensor E^μ, which can be defined as

$$E^\mu = e g^{\mu\alpha}\frac{dx_\beta}{ds}P_{\alpha\beta}, \quad . \quad . \quad (11)$$

where e is the invariant electric charge and $P_{\alpha\beta}$ is defined by the equation

$$P_{\alpha\beta}=\frac{\partial k_\alpha}{\partial x_\beta}-\frac{\partial k_\beta}{\partial x_\alpha}, \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where k_μ is the electromagnetic potential tensor, having for its components the three components of the vector potential and the one scalar potential of the electromagnetic theory. Now it is interesting to note that if we combine the mechanical forces acting on a charged particle due to gravitation and electromagnetic forces into a single expression, and if we take them for the Galilean system, the values for the "velocity" term of equation (6) fit in the diagonal of zeros in the following array for $P_{\alpha\beta}$, leaving the other values of the array unaltered:

$$P_{\alpha\beta}=\begin{array}{cccc} 0 & -\gamma & \beta & -X \\ \gamma & 0 & -\alpha & -Y \\ -\beta & \alpha & 0 & -Z \\ X & Y & Z & 0. \end{array}$$

Thus we have shown that if we adopt the scheme of equations given above, we can return to the mechanics of Galileo and Newton, with the suggested alteration in the law of gravitation, still holding fast to the ideas of inertia and force and the invariance of mass, without being obliged to make mass dependent on velocity and to obliterate the difference between mass and energy as the special and general theories of relativity would lead us to believe, of course, the variable inertia of electrons at high speeds could well be seen to follow from equations (3) and (11), leaving the notion of the invariability of mass intact.

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The Biology of the Suez Canal.

THE Cambridge expedition, financed by the Royal Society, which left England in September last to study the migrations of marine organisms through the Suez Canal (see NATURE, vol 114, pp 520, 866) has returned on the Orient liner *Ormuz* The members of the expedition were Messrs H M Fox, R Gurney, V C Robinson, and D N Twist The full results will naturally not be known until the collections have been worked out, but certain general conclusions can already be drawn

Since the communication to NATURE of December 13 last, the central and northern portions of the Canal have been studied Lake Timsah in the middle region of the Canal near Ismailia is characterised by great variation in salinity, unlike the Great Bitter Lake farther south where a high salinity is constant In the centre of Timsah, with a south wind and a current to the north, a density as high as that of the Great Bitter Lake is recorded In other circumstances the density in the same situation is much lower At the edges of Timsah, and in the lagoons communicating with it, all intermediate degrees of brackish water to pure fresh are found The fauna in various portions of the lake is consequently diverse, and in the situations where rapid salinity changes occur must be resistant to these.

It is remarkable that whole large groups of animals, such as anthozoans, echinoderms, brachyuran crustaceans, ascidians, etc, which were absent from the Canal in 1882, are now abundantly represented Yet the Canal was opened in 1869, and certain forms such as barnacles and cockles established themselves in the region of Lake Timsah from the very commencement Why then did these other groups migrate in so late? In Lake Timsah the contrary phenomenon is found in the case of Mytilus and Pholas, previously very common, now absent An attempt is being made to correlate these arrivals and departures with changes in the Canal at different dates The late immigration of the crab *Neptunus pelagicus*, for example, which started from Suez in 1893 and reached Port Said in 1898 (NATURE, vol 113, p 714), coincides with the first widening and deepening of the Canal. Again, when the water samples brought back by the expedition had been analysed and compared with past data, the proportions of the dissolved substances in the waters of the Bitter Lake may be found to have altered at a certain period owing to the upper layers of the bed of salt which forms the bottom of the lake becoming dissolved Such a change could affect migrations But it must be remembered that in general very little is known about the causes of the migrations of littoral marine animals On a sand flat opposite Port Taufiq, Suez, for example, the writer observed large numbers of Synapta in 1920 At the same season in 1921 the ground was covered in addition by quantities of immature Centrechinus. In 1924 both were absent, although the conditions were apparently unaltered

Between the Bitter Lakes and the Gulf of Suez the currents in the Canal are tidal, reversing their direction twice daily, and they are rapid Between the Great Bitter Lake and Port Said the currents are slow and seasonal, flowing to the north for ten months, to the south for two only, namely, August and September The consequence is that the salter water from the Great Bitter Lake extends north to within 40 km of Port Said (the total length of the Canal is 160 km, and the distance from the Bitter Lake to Port Said 98 km) during ten months, while the less dense water of the Mediterranean penetrates south beyond Lake Timsah (to a distance of 90 km. from Port Said) during two months only The results of this are, first, that for most of the year there is a barrier to the penetration from the Mediterranean of forms which cannot support very salt water, and second, that the salter environment of the Bitter Lake extends far to the north for most of the year with the following possible consequence The fauna of the Bitter Lakes was found to be richer than that of the seas at the mouths of the Canal, but from a study of the Lakes alone it was uncertain whether the favourable factor is a more suitable bottom or the higher salinity. Now between the Great Bitter Lake and Port Said there is a rich fauna on the piers just as far north as the salter water extends during ten months, while between this point and Port Said the pier fauna is noticeably poorer The substratum is the same throughout, but the salt-content of the water different.

The final field work consisted in an examination of the fauna and flora of Port Said harbour Further, the bottoms of tugs and barges which had been employed at one end of the Canal were scraped as soon as they moved to the other end, and again after they had been there some time, in order to see what forms could remain alive in their new environment and possibly could have established themselves there in the past, brought through the Canal on the ships' bottoms

An important side of the work is necessarily incomplete because a part of the Canal fauna is seasonal in its appearance or in its breeding Large Aurelia-like medusæ, for example, are so common in August that they foul the screws of motor boats, yet they were not found by us Many animals breed at a different period of the year, so that we will be unable to give a general answer to the important question

of whether this or that form breeds in its new environment or merely migrates in from the sea during the lifetime of the individual These matters should be further studied by a future expedition working in the spring instead of the autumn

In conclusion, we would like once more to thank the Canal Company for their great generosity in providing lodging and boats and for the unfailing help and kindness of their employés At the same time we must repeat our thanks to the Egyptian Government, in particular to the Coastguards service, for their very willing assistance H MUNRO FOX

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February 6

Short-period Variations of the Wind.

IF one examines the autographic records of wind velocity and direction obtained at any inland observatory on a summer's day, it will be found that both traces are markedly different during the day-time as compared with the night An occasion on which this effect was very well developed is represented in the traces obtained at Porton on July 5-6, 1923 The anemometer vane is mounted at a height of 13 5 metres and has an excellent exposure The direction chart shows that during the day-time the wind is characterised by very large variations in direction These variations are, moreover, of a peculiar type It is observed that the wind assumes a fairly steady and definite direction for an interval of the order of ten minutes It then suddenly swings through an angle of perhaps 60° or even 90° After maintaining this new direction for some minutes, the wind shifts again with equal suddenness Regarded as short-period variations, these shifts are quite irregular in occurrence, although when considered over a period of some hours, the mean direction agrees with that demanded by the pressure gradient In contrast with this behaviour we may compare the trace obtained during the night This is the normal type of trace in which deviations from the mean direction are both small in amplitude and of short duration The wind velocity record also shows a characteristic effect during the day-time · short intervals of nearly dead calm alternate discontinuously with intervals during which the velocity is nearly constant with a value of two or three metres per second It may be noted that the durations of these lulls and gusts are about the same as those of the changes in wind direction At night-time the velocity trace becomes normal like the direction trace

The effects described above are much more marked in summer than in winter; they occur during the day and not during the night, and the stronger the sunshine the more pronounced the effect Moreover, an examination of the Shoeburyness records shows that the phenomenon is strongly developed in off-shore winds, but only very slightly in off-sea winds

Attempts to explain this phenomenon in terms of the interchange of masses of air at different heights appear to be unsatisfactory for the following reasons In the first place, observations at Porton tend to show that lulls of this type extend from the ground up to a height of at least 15 metres, and it is difficult to understand how a thin layer of air lying on the ground can be extended to this height In the second place the experimental evidence seems to indicate the non-existence of descending currents which would be adequate to cause the gusts In this connexion Mr C E Britton has kindly examined the pilot-balloon observations made at Shoeburyness, and he finds that, under conditions of strong convection, descending currents are conspicuous by their absence (The vicinity of cumulus clouds is, of course, not being considered) Thus in all probability the cool descending currents are comparatively slow and are spread over wide areas In this event they will not retain their initial high velocity in the manner necessary to produce the observed gusts

As an alternative to this explanation, it occurred to Mr O F T Roberts and the writer independently that the phenomenon might be caused by small travelling zones of reduced pressure Such areas of reduced pressure are presumably to be found at the base of columns of ascending air on days of strong convection The inflow of the surrounding air towards such centres will necessarily constitute miniature cyclones These miniature cyclones will travel with the general air movement, and their passage will produce, on the present view, the particular type of gustiness which we are here considering Thus, if one of them passes an anemometer so that its own circulation assists the general air movement, then a gust will be produced, and similarly if its circulation opposes the general air flow, then a lull will result It will also be seen that the passage of miniature systems of this type will give rise to the particular kind of direction variation which is associated with this form of velocity gustiness

Considering the duration of this type of gust in conjunction with the wind velocity, it appears that a common value for the "diameter" of these miniature cyclones is of the order of a kilometre By the aid of Ferrel's equation, it is possible to calculate the reduction of pressure necessary in one of these systems to produce a gust of 2 metres per second in an otherwise still air In this case the cyclostrophic term is far more important than the geostrophic term, and it is found that a pressure difference of about one-twentieth of a millibar is required Conditions corresponding approximately to this case occurred between 1100 h and 1300 h on the date already referred to The microbarograph trace for the same period shows quasi-periodic variations of about one-twentieth of a millibar, and of roughly the same "frequency" (about 8 to 10 per hour) as the gusts Similar results are found on other days of strong sunshine and light winds

It is interesting to observe that, since the geostrophic effect is so small in pressure systems of this size, the direction of circulation within them will not necessarily always be that of full-sized cyclones in the same hemisphere The direction of rotation will rather be determined by the initial velocity of some part of the air which goes to form the new miniature cyclone. For this reason gusts and lulls will sometimes be accompanied by temporary veerings in the wind direction and at other times by backings

Interpreted in terms of eddy-diffusion, the effect described above may be regarded as implying a very large value for the horizontal components of the coefficient of eddy-diffusion if considered over a long time interval But if considered over a period of say half an hour, then the effect can only be regarded as irregular The special characters assumed by the wind velocity and direction in these circumstances may also be regarded as special types of variation in the longitudinal and lateral components of the wind It is a matter of some interest to ascertain whether, under the same conditions, the vertical component of the wind acquires any corresponding peculiarity Although it has been shown by Taylor (Advisory Committee for Aeronautics, Reports and Memoranda, No 345) that in general the longitudinal, lateral, and vertical components of gustiness are

approximately equal, it was thought worth while to construct an instrument which will provide continuous records of the vertical component of the gustiness of the wind. Such an instrument is now in operation at Porton, and it is hoped that it will throw further light upon the nature of the short-period variations of the wind near the earth's surface.

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Estimating the Qualities of a Photographic Plate.

THE testing of photographic plates presents to-day a number of complexities, and is so wholly unsatisfactory from a technical point of view that two special meetings have been convened by the Royal Photographic Society, held on January 7 and February 10, at which discussions have been held, and suggestions made, by leading authorities for a better system of estimating the speed and general characteristics of sensitive emulsions. A special committee has also been appointed to consider the suggestions resulting from these discussions, which are to be forwarded to an international gathering in Paris next June, where it is hoped that some new system may be generally agreed upon.

The accepted method of plate-testing, devised by Hurter and Driffield in 1890, is to expose sections of a plate to a standard light source for times increasing geometrically, and after development under standard conditions to measure the densities of these strips and to plot them as ordinates against log exposure. The result is a curve of the well-known form shown in Fig. 1, *PQRS*. But with the very great increase in speed of modern plates these "characteristic curves" often show a type of curve like *XYZ* in Fig. 1.

In curve *PQRS*, *PQ* is termed the under-exposure

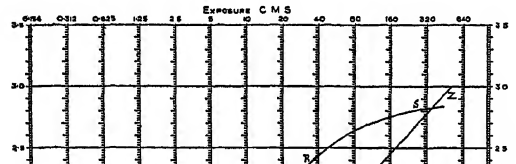

FIG. 1.

portion, *QR* the straight-line portion, representing the "period of correct exposure," and *RS* the over-exposure portion. With many high-speed plates *PQ* stretches out to *XY*, i.e. the under-exposure portion becomes straight, and indeed most studio negatives as made by the professional photographer of to-day utilise only this part of the curve; on higher exposures the curve may jump upwards, as shown by *YZ*, such a plate giving good density in the extreme "high-lights," but soft, uniform gradation in the half-tones and "shadows."

If the straight-line portion of curve *PQRS* be produced to cut the log exposure axis at *L*, *OL* represents the inertia of the plate, and its reciprocal represents the speed; $34/OL$ gives the accepted H. & D. speed number.

Nietz has, however, shown that if several plates,

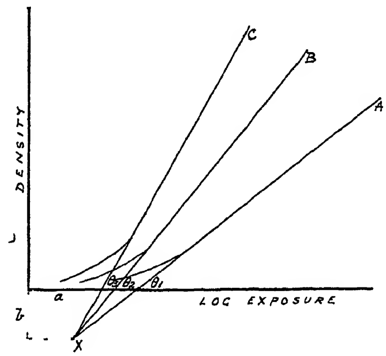

FIG. 2.

given the same exposure, be developed for different times, and their curves plotted, such curves, *A*, *B*, and *C* for example in Fig. 2, may intersect at some point *X*, *below* the log *E* axis if there is free bromide present in the silver bromide emulsion, as is almost invariably the case. In such a case the inertia, as seen, will vary according to the time of development, and he suggests using the co-ordinates *a* and *b* in making the speed determination.

The contrast-giving power of the plate is measured by the steepness of the curve, and is called the development factor, γ. This is proportional to tan θ, and clearly γ will be different for different times of development, being $k \tan \theta_1$ for *A*, $k \tan \theta_2$ for *B*, and $k \tan \theta_3$ for *C*.

Here, then, are some of the difficulties with which we have to deal, and on which some general convention is so urgently needed. Take curve *XYZ* in Fig. 1, for example. Shall we extend *ZY* to meet the log *E* axis to give the inertia, or shall we extend *YX*? Shall we plot a family of curves developed for different times, and use the co-ordinates *a* and *b*, where the speed number *H* could be obtained independent of the contrast-giving powers of the plate by using an equation of the form

$$\log H = \log k - a + b?$$

Another difficult problem is to express the under- and over-exposure parts of the curve simply. *PQ* (Fig. 1) is of paramount importance to photo-engravers in the making of half-tone and line reproductions, as on it depend the "woolliness" of the dots and diffuseness of edge of a line. *PQ* and *RS* are of vital importance to the physicist where he is attempting to measure either light intensities or radiations by means of *density*,—the only portion of the curve that may be used is that in which log density/log exposure is absolutely constant; i.e. he must use *QR* only.

The wave-length limits of the light source also affect gradation to some extent, and some primary and secondary source of light, universally adopted, is most desirable.

The position may be summed up by saying that, in view of the very extended applications of photography to science and industry, and the extensive

use of half-watt lighting for studios by the portrait photographer, some fuller means must be found for expressing the characteristics of a plate and for interpreting its properties T THORNE BAKER

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Excitation of Forbidden Spectral Lines.

HANSEN, Takamine, and Werner (*Kgl Danske Videnskab Selskab Mathfys Medd* 3) have observed the line $1S - 2p_1$ (Paschen's notation) of mercury in a condensed discharge, and Takamine and Fukuda (*Phys Rev* 25, p 23, 1925) have found the line strongly developed in the glow of a branched arc We have excited this line, the corresponding line of zinc, and both $1S - 2p_1$ and $1S - 2p_3$ of cadmium in the positive column of a hot-cathode discharge The positive column was viewed end-on while the cathode glow was confined to a side tube The potential difference across the entire tube was of the order of 100 volts, but the tubes employed were of such length, 30 to 100 cm , that the voltage drop per mean free path of an electron was quite small The spectrum is strictly of the arc type, only a few of the more readily excited spark lines appearing, and these in comparatively low intensity

The cadmium lines, $\lambda\lambda$ 2239, 2267, 2307 and 2329, were sharply absorbed by the positive glow, a spark under water or discharge in a hydrogen tube being used as the continuous background These lines have been independently classified by both Ruark and Paschen (unpublished) as belonging to the group $2p - 2p^1$ Other members of this group involving transitions from the $2p_1{}^1$ level were definitely not present in absorption An unknown line at λ3086 7 appeared on some of the exposures as a weak but sharp absorption line

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Radio Reception on Frame Aerials.

EXPERIMENTS in the reception of medium-powered distant broadcast stations on small frame-aerials of particularly small high-frequency resistance, with the use of correspondingly light reaction-coupling of the type usually associated with the name of Reinartz, appear to indicate that the commonly-accepted ideas as to the magnitude of the high-frequency voltages which can be registered on such aerials with small total tuning capacities across them, in these circumstances, require some modification

With a frame of approximately circular form and 1 m diameter, with 11 turns of thin bronze strip 6 mm wide, spaced at 8 mm in the form of a flat spiral (2 extra turns providing the Reinartz reaction-coil) , and using a detector-valve and one transformer-coupled audio-frequency amplifying valve, both of amplifying factor M = 20, I was able to observe clearly intelligible speech and music from about thirty British and Continental stations, ranging from Aberdeen to Rome, in the course of one Sunday evening, in a quiet high point 35 miles N of London, and on the first floor of a substantially-built house Many of these stations, including the last mentioned, were later audible on a loud-speaker in a very quiet room; corresponding to a R M S audio-signal-voltage of an average order of 0·3 volts. I had previously observed that, with an additional high-ratio transformer-coupled audio-frequency amplifying valve (three valves in all), at least two American broadcast stations could occasionally be heard, subject to the usual fading, on an even smaller aerial

The tuning and reaction-control were of an unusually fine order , and oscillation-hysteresis had to be carefully eliminated The signal-voltages observed here appear to be inconsistent with the usual estimates, and suggest also a revision of current practice in " radio-frequency amplification "

A D COWPER

An Experiment with a Stroboscope.

ON page 543 of vol III of the " Dictionary of Applied Physics," an experimental arrangement is described where the stroboscope disc is illuminated by an intermittent light, using a neon-tube, an induction coil, and an electromagnetically controlled tuning-fork The same experiment can be performed in the light of an ordinary neon filled 110-volt Osglim lamp to which current is supplied from an alternating-current lighting circuit If the laboratory supply is of continuous current, then the arrangement can be considerably improved with the use of a rotary convertor the speed of which can be regulated so that the frequency of the intermittent light can be ascertained directly with a speedometer and stop-watch As a demonstration experiment this arrangement is particularly convenient, since both the stroboscopic disc and the frequency of the source of light can be varied at will, and very interesting effects may be observed G R PARANJPÉ

Royal Institute of Science,
Bombay,
January 2

The Crisp Collection of Microscopes.

MAY I add a note to the brief statement referring to the Crisp collection of microscopes in NATURE of February 14, p 241 ? Doubtless it is true that on occasion the late Sir Frank Crisp may have led the authorities to believe that he contemplated leaving his collection to the Science Museum at South Kensington, but it is equally true that his chief desire was to see his collection used for the preparation of a comprehensive history of the microscope in amplification of Mayall's Cantor Lectures, printed in 1886 Some years ago he asked me whether I would be willing to compile such a history, and he gave me a few notes on his instruments for the purpose Last week I received a letter from my friend Prof Poulton, in which he recalled a conversation with Sir Frank Crisp " I remember his telling me that he did not know what to do with it (the collection), and I tried to persuade him to leave it to the Pitt Rivers Museum. If the collections now in the Old Ashmolean had been there, then I expect he would have left it to Oxford " This I believe to be the truth Sir Frank Crisp did not desire to duplicate the series in the possession of the Royal Microscopical Society, or that his collection should be merged in a larger one, and only be partly exhibited But the facts that many of the parts of the instruments have got mixed, that historic examples have been divorced from their history, that the collection has been distributed without having been properly catalogued, is an international calamity.

R T. GUNTHER.

Magdalen College,
Oxford,
February 14

The Investigation of the Properties of Thin Films by Means of X-rays.[1]

By Sir WILLIAM BRAGG, K.B.E., F.R.S.

THERE are a number of problems of the highest importance which are, or can be, contained in the study of what we often call the "thin film." They are linked together by the fact that most reactions between bodies are largely determined by what takes place at their points of contact, and therefore by the nature of their surfaces. What is to be found in the interior of the body is often of much less importance than the composition and state of its surface film. The immensely varied problems of surface tension are examples of one kind: the phenomena of catalysis, of friction and lubrication are examples of other kinds.

Though the thickness of the surface film is so important, it is often very small—beyond the limits of direct optical measurement. The X-rays measure more minute quantities than the microscope, and we may well ask if they can carry us any further. They measure only, it is true, the spacing of a stratification, and a stratification cannot consist of a single layer or film: so that the rays cannot be applied directly to the examination, for example, of the black spot on a soap film. But they are able to help in an indirect yet effective way. For they deal with problems of the arrangement of molecules, and all these manifestations of surface action are directly dependent on the arrangement of the surface atoms and molecules. Also the substances, the actions of which in single thin films are of great interest, are often found multiplied into crystals which actually can be examined by the X-rays.

The soap bubble and soap film have long been studied for their beauty and their interest. Since they have so large a surface in comparison with their volume content, they offer special advantages for the examination of surface actions. Yet they are so full of detail that even with the last few years new and most interesting discoveries have been made with respect to them. It will be convenient to review some of these briefly as illustrations of the facts that have to be accounted for.

When the bubble is near its end a black patch often appears, and soon afterwards the bubble bursts. The patch is black because it is so thin, and therefore reflects little light. It might be thought that the "black spot" represents a breakdown in the structure, a forerunner of collapse. But it is in reality a relatively stable affair: in proper circumstances it can be maintained for hours and days, as Sir James Dewar loved to show. Reinold and Rucker, Rayleigh, Johannot, and many others were greatly interested in the sharpness of its outline, its thinness, and the uniformity of its texture. They recognised two degrees of blackness, as Newton had done long before; they supposed them to represent a single film and its duplication. They succeeded in measuring the thickness, and estimated it to be about 60 Ångstrom units in the case of the thinner and twice as much in that of the thicker.

When a film is correctly prepared and mounted, the black spot appears at once at the top of the film, a horizontal line separating it sharply from the rest with its horizontal bands of colour. Small black spots are continually forming at various points of the coloured film and rushing up to join the main spot: it is, of course, the downward movement of their surroundings which makes them move in the opposite direction. Sometimes minute points of light like stars appear, moving about on the surface and especially at the edges of the black spots—drops of water apparently.

When observations of this kind are made in the quiet of a laboratory, with small and more manageable films and with special instrumental facilities, a fineness of detail is revealed which cannot be followed on the screen. Our knowledge of these details is due to the beautiful work of Perrin, published in 1918, and to its repetition by Wells in 1920. To state Perrin's results very briefly, it appears that the two degrees of thickness first observed are due to the existence of a very thin uniform film and its doubling, as had already been shown; that the existence of three more degrees of blackness observed by Johannot was due to further repetitions of the same layer, and that a close examination revealed the existence of dozens of these layers, all multiples of the same fundamental thickness. In the blackest spot there was but one layer, and this was, strangely enough, the most stable of all. Other similar layers could be found superadded, like sheets of paper of the same uniform thickness, until the film was thick enough to show the rich colours of Newton's rings which the soap film ordinarily displays. As we know, the colour of the film is an indication of its thickness. For example, the colours proceed from black through greys, becoming lighter and lighter as the thickness increases, then to a nearly pure white, then through straw-yellow, yellow, orange-red, dark red to a violet, which always changes very quickly with alteration of thickness, and so forms a definite stage. The thickness has now reached (for water) about 2100 Å.U. Perrin counted 37 to 38 steps by which the superimposed sheets mounted to the full thickness that gave the violet tint. He made measurements also with monochromatic light and as his final result arrived at the conclusion that the thickness of the single film was about 52 Å.U. Wells found a somewhat smaller value, namely, 42 Å.U. Perrin, and Wells after him, concluded, on evidence which we have not time to consider, that the single film was composed of a double layer of oleic acid, arising from the hydrolysis of the sodium or potassium oleate in solution.

Now Rayleigh, Devaux, and more lately Langmuir, Hardy, and Adam have measured the thickness of an oil film spread on the surface of water. It appears that in the case of a fatty acid such as stearic or palmitic, when the surface is fully charged, the long chains stand on end, their carboxyl terminals rooted in the water, for which they have a great attraction, and their methyl terminals are turned outwards. The length of the oleic acid molecule is about 23 Å.U. It is clear that this length can easily be in agreement with the suggestion made by Perrin. His film of 52 Å.U., or 42 Å.U. according to Wells, would consist of two layers of oleic acid molecules, the carboxyl ends meeting in the centre. The molecules are held together, side by side, to form a strong sheet, while the methyl groups form a surface reacting very slightly with anything outside.

[1] Discourse delivered at the Royal Institution on Friday, January 16.

The examination of crystal forms by means of X-rays shows that the peculiar arrangement of the molecules in these films on water extends also to the solid crystal in a great number of cases, and may probably be considered as characteristic of the structure of a large and important class of substances. It is in the first place to be found in the solid forms of the fatty acids, hydrocarbons, alcohols, and other long-chain molecules. These have been examined by Piper at Bristol, and by Muller and Shearer in the Davy Faraday Laboratory. I referred to a few of these a year ago. The number examined has been largely increased during the last twelve months, and the results that have been obtained are ready for publication.

When a small quantity of one of these substances is placed upon a plate of glass or mica, either by melting or by pressing, a formation of layers results, much more so by the latter operation, for it would appear that the pressing and working encourage the arrangement of the molecules and the regularity of the layers that are formed. The material is now placed on an X-ray spectrometer, and a photograph is taken by the method of the revolving crystal. The photographic plate shows usually a number of lines which clearly represent the orders obtained by reflection from the plane of the layers. In this way the thickness of the layer can easily be measured with an accuracy of about 1 per cent. Ten or more orders are often observed. The cleavage plane of many crystals, especially of the class I am describing, often gives several orders, but not usually so many as in this case: other reflecting planes may give only one, perhaps two, higher orders of moderate strength, more often only very weak reflections, except in the first order. No doubt the case is parallel to the well-known effect in optics, where a grating yields many orders of spectra when the lines are sharp and fine. The "line" in this case is a well-defined discontinuity in the distribution of scattering centres which occurs at the ends of the long molecules; a defect would be caused by the presence of the hydrogens of a methyl group, an excess by the oxygens of a carboxyl group. We may suppose the planes which separate layers of these molecules to be well marked in this way, and that otherwise there is a fairly even distribution along the body of the molecule.

If we plot the spacing of each substance of any one series against the number of carbon atoms in the chain, we find at once that the indicating points lie exactly on a straight line, except when the chain is short. This has been proved by Muller and Shearer for the fatty acids, hydrocarbons, alcohols, ketones, and in other cases, and the regularity of the results leaves no doubt as to facts. The increase for each carbon atom is either about 1·0 Å.U. or 1·3 Å.U., the former occurring in the fatty acids, for example, and the latter in their esters.

If we may assume that the molecules lie perpendicularly to the layer, the numbers found for the thicknesses are actually the lengths of the molecules, and there is some ground for supposing this to be often true. But, of course, the molecules might *not* be normal to the layer, in which case the length of the molecule would be more than the thickness of the layer. It is certain that this may sometimes be so. Small crystals of substances of this class have been obtained and successfully measured in these laboratories by R. E. Gibbs, in spite of the fact that they each weighed only about a hundredth of a milligram. Gibbs finds that the crystals are of monoclinic prismatic form.

In this instance, then, the molecule is not upright but sloping. It is difficult to imagine that the molecules all slope one way in the oil films on water; there would surely be some unique and recognisable direction in the film. It is possible that the explanation may be found in the fact that there are actually two ways, perhaps several ways, in which the molecules arrange themselves. Gibbs has found an orthorhombic as well as a monoclinic form; and Muller has observed that a hydrocarbon gives a somewhat different value for the spacing when it is only a few degrees below its melting-point. The physical appearance is different in the two cases. In the latter the film is translucent; in the usual case it is opaque, probably on account of minute crevasses formed during shrinking. This may be the cause of the change we see passing over cooling candle grease: it is transparent one moment, and suddenly clouds over.

The inclination of the molecule to the plane of cleavage must be finally settled before we are quite sure that we are measuring the actual lengths of the molecules, but we may hope for an early solution.

The fatty acid molecules are in double layers, but the hydrocarbons are not. We know this in two ways. In the first place, the actual increase in length for each carbon atom is twice as great in one case as in the other. In the second place, the even orders of the fatty acid spectra are very weak compared to the odd orders.

Such an effect can be produced in an optical grating by an alternation of white and black lines on a grey ground. An alternation of strong and weak black lines gives strength to the even orders: substituting white for one of the blacks is equivalent to changing the sign of its contribution. Gratings can be so made as to illustrate the point. If molecules pointing opposite ways are joined by their carboxyl terminations, then the methyl ends of the molecules are weaker in scattering centres than the general average along the molecule, but the parts where the carboxyl groups join together are above the average in strength.

Shearer finds another illustration of this effect in the case of hydrocarbons which form a single layer, but are converted into ketones by the substitution of oxygen for hydrogen at some point of the length. When the substitution is at the middle of the chain, there is at that point an excessive number of scattering centres, and we have again the circumstances that cause reinforcement of the odd orders. But if the substitution is not at the middle of the chain, the odd orders are no longer strong compared to the even.

We have, therefore, in these stratified layers which we are examining by the X-rays, the very same formation that Perrin has observed in the liquid films. The molecules are found, without exception, to be extended to their full length, and linked together by their carboxyl terminals. Shearer finds the length of the double molecule of oleic acid to be about 36, which is to be compared with the 52 of Perrin and the 42 of Wells.

The conditions which lead to the formation of films on a water surface, and layers in the fatty acids and similar bodies, are operative also in the case of a large

number of more solid crystals A certain flakiness is the result, the crystals cleaving very easily into thin layers which slide readily on one another, and often give a greasy feeling to the crystal

Naphthalene and anthracene are cases in point. Their molecules are long and narrow, and are arranged side by side like the oleic acid molecules on water. A single layer is like the corn in a field, but they lean over like the corn when a wind is blowing. They are not perpendicular to the layer. The bonds that tie the molecules side to side must be stronger than those that tie them end to end, because the flakes are so easily parted from one another The naphthalene molecule contains two hexagonal rings of carbon atoms and the anthracene molecule is extended by the addition of a third, so that the layer is thicker in the latter case. In both cases the molecule has a centre of symmetry, and in each layer the molecules are divided into two classes in respect to their orientation Any member of one class is joined up by ties of some sort to several (probably four) members of the other class, which immediately surround it in the flake; and it would seem that this cross linking holds the flake together and gives it its strength.

It is likely that a very large number of other substances are built on the same plan Even when their examination has not yet been attempted by means of X-rays, their crystallographic measurements suggest the fact.

In other substances a similar external form is attained by a somewhat more complicated internal arrangement The molecule has of itself no centre of symmetry, in fact no symmetry at all, and twice as many are required in the construction of the monoclinic prismatic unit of pattern This is the case, for example, with benzoic acid, and probably with many of its derivatives But there is the same flakiness which may be put down to the same causes (1) the general orientation of the molecules so as to lie across the flake, and (2) the hydrogen terminations In all these cases we find that the crystal is tied together by links extended from each molecule to neighbours of the other possible orientations · this seems to be an essential feature of crystal construction It cannot, of course, be followed in the lowest type of crystalline symmetry, where there is but one orientation possible, and every molecule is arranged exactly as every other. But though this arrangement can be conceived, it is doubtful whether there is a known case it has been shown by Astbury that calcium thiosulphate, generally quoted as the solitary example, has probably the symmetry of Class 2, which contains two orientations, connected by a centre of symmetry Whether this is so or not, it is certain that in at least the vast majority of cases, cross linking is an important feature It may very likely be a factor in the determination of the faces that appear on a crystal. A face will naturally contain specimens of more than one molecular orientation, so that the elements of the face may be tied together strongly For example, in naphthalene, as in many other cases, all the usual faces contain equal numbers of molecules of the two orientations one might even predict the arrangement from the knowledge of the form

If, therefore, we survey the general characteristics of this large class of flaky crystals, we observe that the monomolecular films of Langmuir and the multiple stratifications of Perrin, and the whole range of "thin films," have much in common with the solid members of the class. Yet there are significant differences It seems possible by studying both resemblances and differences to obtain some fresh light on the properties of the more "liquid" films

With these facts before us we may perhaps formulate a more detailed theory of the black spot on the soap film The ordinary thick film is bounded on each side by the monomolecular film of oleic acid In this film there is certainly arrangement Adam, in particular, has examined the compression of the film under applied forces, and his observations and conclusions fall in naturally with the ordered array that we should expect to be there. But the film is imperfectly crystalline. It is compressible up to a certain point, and during the range of compression may be considered as a two-dimensional gas The perfect crystal of this class of substance is found in the films studied by Muller and Shearer, and in the minute crystal which Gibbs has measured The perfect crystal of oleic acid contains twice as many orientations as the film of oleic acid on water the molecules on the water are only one way up, and the reversed molecules are required to complete the structure

Suppose, however, that the oleic acid films on the two sides come into contact anywhere, the conditions for the completion of the crystalline structure are now all present. The carboxyl groups not only meet, but interlace. each molecule in the upper group linking together two or four molecules in the lower, and vice versa This is doubtless a far more stable form of arrangement than that of the single film The two outside single films, once united in one place, must increase their area of contact, and will drive the expelled water before them until the accumulating heap becomes too great for them to push any further, the action being assisted by the tension of the rest of the film

The film thus formed is a real crystal, because it contains all the molecular orientations. The black spot is simply the thinnest possible flake of oleic acid It is true that oleic acid melts at 11° C, but the crystalline structure is there, in a mobile state Solution cannot be made to enter between the two surfaces now united in crystalline fashion Other films may be formed and float about on it, holding on by virtue of the feeble attractions of the methyl groups on one another even the pressure of the air must help in keeping them together These added films will slide about easily, they also will be true crystals of oleic acid, probably without any water.

The differences between the conditions and structure of the black spot on one hand and the neighbouring thick film on the other are so great that we may cease to wonder at the sharpness of the boundary and the enormous change in thickness · on one side of the boundary the thickness may be hundreds of times as great as on the other.

When the black spots appear and rise through the thick part of the film to join the general black area at the top, they leave trails behind them: they look like tadpoles swimming up to the top of the water When the motion becomes less violent the tails shrink into small circular spots On the other hand, if a thick

patch is forced by the general turmoil into the middle of a black film, it tends also to a circular shape

We come now to another of the important surface effects, namely, that of friction, or, stated inversely, of slipperiness These flaky substances are in general slippery and greasy to the touch The greasy feeling seems to be due to the ease with which the flakes are split from the main body of the substance, and then slide over it Graphite is an extreme example of the flaky state and without forcing its inclusion in the class of substances we are considering, we observe that the atoms in each flake are tightly tied together, and that there is a very weak linkage between a flake and its neighbours It is the combination of these conditions that makes for good lubricating qualities Now in these substances the same conditions hold to a greater or less extent · the molecules of stearic acid, for example, are tied together more tightly side to side than across the ends at which the methyl groups are attached If, therefore, stratification exists to any considerable degree, the same consequences follow as in the case of graphite In general, stratification is incomplete, which is another way of saying that a large perfect crystal of stearic acid is never seen. Pressure is one agent that causes stratification, so that if one presses a piece of stearic acid or other material, the very pressure produces the conditions for easy slipping I have already mentioned that Shearer and Muller have often found that a portion of the material melted on to a piece of mica or glass, and placed on the spectrometer in the necessary position for giving reflections from planes parallel to the glass, was comparatively ineffective in this respect It would give clear evidence of those two spacings which are found on all the plates, and are ascribed to the widths of the molecules and are independent of their lengths When the specimen was pressed, or rubbed down on to the plate, the stratification spacing appeared at once, and the others disappeared, thus showing the nature of the rearrangement that had taken place It may be that this effect explains other properties of greases. I am told that the special grease used in binocular fittings is made serviceable by working with a palette knife

We must recognise, however, that the layers built into the crystal are not at all times ready to slide, otherwise a mere tilt of the crystal would cause them all to slide off one another like a pack of cards There is a sticking friction to be overcome, exactly as in graphite. It is only possible to speculate as to the cause perhaps it is a real molecular effect, and sliding only occurs when the bonds, weak as they are, are further weakened, as if the substance was about to melt perhaps it is rather a mass effect and due to imperfect crystallisation

It seems not unlikely that, at its best, slipperiness in these cases is almost perfect Between two perfectly formed methyl layers there is very little friction indeed, perhaps none at all The methyl layer is seen at its best on the surface of the black spot in the soap film, and various writers have noted that one layer slides very easily over the other. Perrin, in fact, has directed attention to this remarkable effect, as shown in the Brownian movement of fragments of one layer, lying on and sliding over another

In some of the experiments of Sir William Hardy and Miss Doubleday the condition of nearly complete slipperiness is attained Their beautiful researches on "boundary lubrication," that is to say, the slipperiness of very thin films, have established certain rules of surprising simplicity They have found cases in which friction nearly vanishes, and in general accordance with the above, they frequently occur when a solid lubricant is practically wiped and rubbed off the surface, a true stratification in a very thin film being probably left.

Not only the phenomena of surface tension and of lubrication, but also those of catalysis, must be intimately connected with the actual arrangement of molecules We speak of stereochemistry as showing the relations of the atoms in the molecules to one another, their mutual orientation and distances To deal with these subjects we shall have to extend stereochemistry to cover the mutual distances and orientations of molecules as well as of atoms We see that we must not treat a molecule as if it were simply a sphere attracting according to gravitational laws it is not even sufficient to speak of an atom in this way, except as an approximation in the case of ionic substances like rock-salt If some super-Brobdingnagian inquirer were to argue from effects observed on the surface of the earth as to the nature of the human beings to which the effects were ascribed, and being unable to detect a single individual by the most refined methods of which he was capable, should say, "Let us provisionally assume the human being to be a sphere, having similar properties in all directions and no special points of attraction," he would not get very far towards a satisfactory explanation of his subject. It would be an advance should he recognise the existence of two types of opposite sign, and lay the foundations of an ionic theory of heteropolar assemblages, but even then he would fall far short of the truth In the same way, when we try to explain surface tension as the result of the mutual gravitational attraction of spherical atoms or molecules, we cannot make much progress Indeed, we sometimes arrive at consequences that appear startling, as when we determine their attractions by measuring the energy required to tear surface molecules away in the process of evaporation, and then proceed to deduce the existence of pressures of thousands of atmospheres within the body of a liquid. So we may measure the force required to tear away the fringing links of a piece of chain mail, take them to be due to mutual attraction between the links, and thence deduce the existence of an enormous pressure within the piece

It is when we consider a catalytic surface as possessing active centres on its surface, the relative positions, magnitudes, and mutual distances of which are such that two wandering molecules of different kind, attracted by these points, may be held together in a special way, that we get some idea of the fundamental action of catalysis It is important to consider, as the basis of surface actions, the arrangements of the molecules at a surface, both arrangements that actually exist, and those that are predisposed to exist This idea runs through all the work of those experimenters, Langmuir, Harkins, Hardy, Adam, Perrin, and many others who have made such progress of recent years: the X-ray studies emphasise this view and supply many quantitative measurements by which it may be shaped and strengthened

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R S.

8 THREE GOTTINGEN PROFESSORS, AND AN ADVENTURE.

WHEN I went to spend two months at Gottingen in the summer of 1874, Wilhelm Weber (1804–1891) had just retired from the professorship. I doubt whether the present generation of physicists are familiar with his work, though there was a time when electricians talked about weber-currents, galvanic-currents, and faradic-currents as if they were different things I feel sure, however, that chemists have not forgotten Friedrich Wohler (1800–1882), who occupied the chair of chemistry at the University of Gottingen during forty-six years. Both men were Copley medalists Wilhelm Klinkerfuss (1828–1884) stands on a somewhat lower level of distinction, though he did meritorious work, was amongst the first to recognise the importance of Doppler's principle, and discovered six comets.

When Weber was first appointed to the chair of physics at Gottingen in 1831, that University formed part of the kingdom of Hanover When its connexion with England was finally severed in 1837 by the accession of Ernest August to the throne of Hanover, the new king repudiated the constitution which the country had enjoyed for a considerable time Seven professors of Gottingen protested against this autocratic action and had to leave the country They included, besides Wilhelm Weber, his brother, the physiologist, and Jacob Grimm, the writer of fairy tales Weber was offered a chair at Leipzig, where he remained until he was reinstated at Gottingen in 1849 In 1874, at the age of seventy, he was still full of vigour A short man with a clean-shaven, round, and smiling face, he was ready to discuss the current scientific problems with freedom and sagacity. I much enjoyed the two occasions on which he invited me to join him in his walks along the walls of old Gottingen

A man's mentality often finds significant expression in the way in which he shakes hands. Kopp, of Heidelberg, used to raise the proffered hand slowly to the level of his short-sighted eyes, and keep it there for a few seconds as if wondering what to do with it Weber raised his arm vertically upwards and swung it down in a swift and forcible sweep, as if he really meant it. I was told that, under the influence of Zollner, Weber had taken up spiritualism, but I never knew that side of him

In contrast with Weber, Wohler seemed to live entirely in the past I only spoke to him twice, but while fond of relating old reminiscences, his conversation generally ended in a recital of his personal ailment I can only remember one of his tales He had an official residence above his laboratory, and one night he was awakened by the noise of an explosion He gave a graphic description how, with a candle in his hand, he went down to see what had happened At the point of opening the door—he hesitated Could there still be some explosive gases hovering round the laboratory? He blew out the candle and entered the room, and found indeed that he had narrowly escaped losing his life by a second explosion There is not much in this story, but Wohler seemed to be very proud of this testimony to his presence of mind

I had called on Wohler at the express wish of Roscoe, who sent him, through me, a small flask filled with vanadium salt Wohler was delighted, and could scarcely believe that this was for him to keep and not only to look at He had been doing some work on vanadium himself with only a small quantity at his disposal, and on every occasion that I met him he always expressed surprise that Roscoe could spare so much of it The day following my first call, on returning to my lodgings, I found a visiting card with his name neatly written on it

Klinkerfuss was a man of different type and calibre He generally took his meals in common eating-houses surrounded by students, and occasionally I was one of the party He used to entertain us with inferior jokes One example must suffice "I have always had a remarkable memory for numbers," he said "At school in the history lesson I could remember every date. Unfortunately, I always forgot what happened on the dates" It was said of him that when he received his salary he spent his money lavishly eating and drinking in the most expensive places, and when he had spent nearly everything he lived mainly on sausages and beer His duties sat lightly upon him By a general rule of the German universities, a professor is not obliged to lecture to less than three students (*tres faciunt collegium*), and when at the beginning of term one of them called to inscribe himself for the course which had been announced, Klinkerfuss told him that he would have to find two others who also desired to attend It was said that if half an hour later another man came with the same request, he received the same answer, and it was only when the term was in full swing that the disappointed students became known to each other I do not vouch for the story The facts that the fees go to the professors, and the well-known impecuniosity of Klinkerfuss, speak against it He ultimately ended his life by committing suicide

There was another professor at Gottingen, a philosopher and theologian, with whom I had some acquaintance When I called on him, he warned me that the life in Gottingen was different from that at Heidelberg The students were more formal, and inclined to take offence if one did not conform with their codes of behaviour It was not many hours before I had occasion to regret that I did not attach more importance to his warning The evening of my visit to him I went to some open-air place of entertainment where I met an acquaintance, who was accompanied by three other students He asked me to join his party, but I told him that I was on my way home Ultimately, he persuaded me to sit down for a few minutes While I was talking to him I overheard remarks, made by his companions, about the impertinence of sitting down at a table without a proper introduction I knew I was in for it, but awaited developments Suddenly one of the men got up, placed himself right in front of me, clicked his heels together, and said, "My name is von

[1] Continued from p 234

Eberstein" (the names are imaginary) I gave him my name in return After a minute or two the second man got up "My name is Goldschmidt" I gave him my name When the third man got up I fortunately remembered that I had a trump card to play, and after he had gone through his ritual I replied, "My name is Dr Schuster," laying stress on the title Whereupon all three silently left in a body My degree was a sufficient distinction in rank to justify me in dispensing with the formality of asking for an introduction to them I asked my friend what would have happened if I had not been a graduate his reply was, that I should have had either to fight at least one duel or been treated as an outcast by German universities All this happened fifty years ago, and must not be considered to apply to the present day.

Obituary.

Sir James Mackenzie, F R S

By the death of Sir James Mackenzie the medical profession and the world at large has lost a physician whose life was devoted to the advancement of our knowledge of practical medicine His researches on diseases of the heart effected nothing less than a revolution in this branch of medicine, which had been stagnant for nearly a century

Sir James Mackenzie was born at Scone in 1853, and received his medical education at the University of Edinburgh, where he graduated in 1878 After extending his training by resident appointments in the Royal Infirmary he took his M D in 1882 Then followed twenty-eight years of busy general practice in Burnley, and it was during these years that he made the greater part of the observations which made his fame It soon struck him, as it must strike many medical men, that for the diagnosis and treatment of a vast proportion of illness, his teachers had been unable to give him anything like adequate guidance Mackenzie, greatly stirred by discontent, set himself to the filling of some of the gaps, and two examples of this pioneer work may be mentioned The value of pain as a guide to diagnosis was realised when he found that it was referred from the offending organ to particular areas of the surface of the body through the agency of the nervous system, and that the organ was not itself painful This fundamental change in the conception of pain was independently discovered and extended by Dr Henry Head Another gap so brilliantly, almost completely filled, was the classification of the irregularities of the heart For this purpose Mackenzie invented a clinical polygraph for recording not only the pulse but also simultaneously the venous pulse in the neck It thus became possible for the first time to observe the action of the auricle, which proved a key to the elucidation of arrhythmia Irregularities and murmurs were shown to be significant or insignificant by the rational, though laborious, method of following cases exhibiting them for years until their degree of importance became manifest

Great interest was aroused at home and abroad by the immediate value of these discoveries, and when Mackenzie relinquished his general practice at Burnley in 1907 to take up consulting work in London, he was recognised as the foremost investigator and authority in the world on heart disease His popularity as a consultant was not allowed to interfere with research, which was continued first at the Mount Vernon Hospital and later at the London Hospital The action of digitalis in disease was studied to such purpose that, as Prof Cushny has said, "more progress was made in fifteen years than in the preceding century" The impetus of progress was given to disciples from all over the world, and to them were opened fields of thought and work which seem sufficient for a generation

When the War came, Mackenzie initiated through the War Office a special hospital for the elucidation of problems connected with "soldier's heart." In 1918 he retired from consulting work and went to St Andrews, where he founded the Institute for Clinical Research. He had realised that attention was habitually directed to fully developed disease, so that, as he said, patients seemed to be admitted to hospital when they had the physical signs of obvious disease and might almost be described as incurable He determined to study afresh the nature of symptoms as met with in practice, so as to learn of disease in its early and perhaps curable stage As time went on, he foresaw that the phenomena of disease might be governed by simple laws which he formulated as a basis for further examination by his colleagues at the Institute Then his health failed, but not his faith and courage, and he finally retired to London, where he died on January 26

Mackenzie's personal qualities were an ornament to the greatness and originality of his mind, and endeared him to all his pupils He was indefatigable himself, an inspiring and generous master, a superman, but none was more human His personality will remain as worthy of admiration as was his relentless pursuit of knowledge, not only for its own sake but also for its application in the relief of suffering humanity

In 1911 Mackenzie was appointed physician to the cardiac department of the London Hospital. In 1915 he became a fellow of the Royal Society, and received the honour of knighthood, later he was appointed honorary consulting physician to the King in Scotland. His most important works are "The Study of the Pulse" (1902), "Diseases of the Heart" (1908), "Symptoms and their Interpretation" (1909), "Principles of Diagnosis and Treatment in Heart Affections" (1916), and "Angina Pectoris" (1923)

Mr William Watson

We regret to announce the death of Mr William Watson, which occurred at St Albans on January 30 He was well known in botanical and horticultural circles through his long tenure of the curatorship of the Royal Botanic Gardens, Kew, a position he held from August 1901 until June 1922

Mr Watson was born at Garston, near Liverpool, on March 13, 1858, and received his first appointment at Kew in 1879, following several years' experience in trade establishments His knowledge of tropical and sub-tropical plants was probably unrivalled For many years he was a regular contributor to the

horticultural press, and so long ago as the eighties of last century wrote a valuable series of articles on the Palmaceæ in the *Gardener's Chronicle*. These articles it was hoped might have been republished in book form as a monograph of this natural order, thereby bringing Berthold Seemann's work on the same family up-to-date. This hope, however, was never fulfilled. To vol. 15 of the *Annals of Botany* he contributed an illustrated paper "On the germination of *Bertholletia excelsa*," the Brazil nut.

In later years Watson took a keen interest in the Cactaceæ and succulent plants generally, and his "Cactus Culture for Amateurs" is the standard work on its subject. He also wrote books on "Climbing Plants," "Rhododendrons and Azaleas," and, in collaboration with W. J. Bean, "Orchids, their Culture and Management," all of which met with success. On horticulturists in general he conferred a great boon by editing a new edition of "Thompson's Gardener's Assistant," so much improving it that it became practically a new work. For upwards of twenty years he was editor of the garden section of the *Field*. His life's work, however, was centred in Kew, an institution which owes very much to his forty-three years' devoted service. He was elected an associate of the Linnean Society in 1904.

THE *Chemiker-Zeitung* reports the death on January 6, at the age of sixty-eight, of Dr. Wilhelm Borchers, professor of metallurgy and electrometallurgy at the Technische Hochschule of Aix-la-Chapelle. Borchers was born at the university town of Erlangen, and after completing his studies there, he spent the next four years in a chemical factory as process chemist. The experience thus gained was of immense value to him in his later career as an investigator, for it enabled him to bring to a successful conclusion many difficult researches in the field of electrometallurgy. In 1891 he was appointed lecturer in chemistry and metallurgy at Duisburg, and six years later he was transferred to the Hochschule at Aix-la-Chapelle. His chief interest lay in the application of electrolytic processes to metallurgical problems, such as the production of metallic calcium, strontium, titanium, cerium, etc. He also conducted numerous researches on the preparation and properties of alloys. Prof. Borchers was the author of several books on electrochemistry, and in 1894 he founded the *Zeitschrift für Elektrochemie*, which he edited until 1900. He also collaborated with Nernst in publishing the *Jahrbuch der Elektrochemie*.

WE regret to announce the following deaths:

Prof. Walther Dieckmann, of the Department of Chemistry in the University of Munich, on January 12, whilst carrying out a research in organic chemistry in the State laboratory.

Miss Lilian Suzette Gibbs, known for her work on the mountain flora of Australasia and on problems relating to the geographical distribution of plants.

Dr. E. E. Klein, F.R.S., formerly lecturer on advanced bacteriology in the Medical School, St. Bartholomew's Hospital, on February 9, aged eighty.

Current Topics and Events.

INTEREST in the therapeutics of consumption has again been roused by the reports of successful treatment, this time by a chemotherapeutic agent which, under the name of sanocrysin, has been investigated by Møllgaard, a professor in the Landbohøjskole of Copenhagen. There is no mystery chemically about sanocrysin. It is sodium aurous thiosulphate ($Na_3Au(S_2O_3)_2$) which has long been known as Fordos and Geles salt. Years ago it was shown that gold salts have a powerful action on tubercle bacilli *in vitro* and several gold preparations, simple and complex, have been tried therapeutically with indifferent success. Møllgaard affirms that sanocrysin inhibits the growth of tubercle bacilli in a dilution of 1 : 1,000,000 and that their progress may be completely arrested in a concentration of 1 : 100,000. In non-tuberculous animals sanocrysin is said to be relatively harmless, whereas in tuberculous subjects very stormy reactions follow its exhibition and may actually end in death. It is believed by Møllgaard that these violent effects are to be attributed to certain poisons, of a tuberculin character, which are liberated from the dying and dead tubercle bacilli from the action of the sanocrysin rather than to a direct toxic action of the thiosulphate. It is said that the violent reactions can be lessened or prevented by the administration of an anti-serum produced by the injection of tubercle bacilli or its products. The sanocrysin treatment is really a twofold process. There is supposed to be the direct bactericidal action of sanocrysin and the neutralisation of its poisonous results by an antitoxin of sorts. The Møllgaard treatment has been applied for a considerable time both in cases of tuberculous human beings and animals, but judgment must at present be reserved as to whether it is likely to occupy a permanent place in tuberculo-therapy.

IN the course of his fourth talk on "Ether and Reality" given under the auspices of the British Broadcasting Company at the London station, 2LO, on February 17, Sir Oliver Lodge discussed magnetism and its analogies with life and knowledge. Sir Oliver stated that electrification is a matter of transfer, a transfer of pre-existent charges, a disturbance of equilibrium. When equilibrium is established, opposite charges are close together and disappear from our ken. They never go out of existence: we neither create nor destroy. The same is true for magnetism: we can make a magnet, but the magnetism was there beforehand. Magnetic lines of force differ from electric lines in being always closed loops; all we do is to open them out. They tend to shrink, and thereby pull together two things round which they are looped, like an indiarubber ring. They never shrink up to nothingness. One magnet can produce any number of others, for there is no limit to the amount of magnetisation; what one body gains, the other does not lose. In that respect it is analogous with life. Knowledge in this respect is like life and magnetism: there is an unlimited reservoir from

which to draw, and the imparting of knowledge does not lessen the amount possessed by the imparter, it is transferred without loss, though doubtless with the expenditure of some energy Knowledge grows from more to more By diffusion it is increased, what one gains, another does not lose A magnet which has excited other magnets may be even stronger than before life which has excited other life may still be vigorous So far as we learn from science, nothing goes out of existence, it only changes its form and may become inappreciable to our senses

A COGENT restatement by Dr R P Scott of the case for co-operation between England and China on certain lines and under certain safeguards appears in the current issue of the *Contemporary Review* Those who are best acquainted with conditions in China are by no means so pessimistic as to the outcome of the present situation as the political news appearing in the Press might appear to demand Private advice from China, however, indicates that this news is by no means exaggerated and that the social and commercial situation is serious Dr Scott lays great stress upon the pre-revolutionary character of Chinese ideals in pressing that side of his argument which rests upon the fundamental similarities between the English and Chinese mentality. These, he holds, find their most significant expression in the qualities characteristic of the English "gentleman" and the Chinese "princely man," as well as in business faculties, and in humour Granting that co-operation is both possible and desirable, of the various suggestions put forward there is much to be said in favour of education as the field Dr Scott points out that it is the only one in which continuity can be obtained, and further, it is one to which each of the parties brings something distinctive—the Chinese, a thoroughness of mental grasp, and the English, breadth of outlook Without attempting to displace literary studies, we could add instruction in those branches of science, especially the higher branches of physics and of surgery, for which the racial characteristics of the Chinese are peculiarly apt, but in which at present they lack opportunities of training Dr Scott quotes a letter from the Chancellor of the National University of Pekin which should set at rest any doubt as to the willingness of the Chinese themselves to co-operate in this field While Chinese ethical standards must be respected, what is needed in the opinion of the Chinese themselves is the spirit and tradition of our best public schools Dr Scott concludes by indicating in outline the means of attaining this object through joint membership of the Foreign Office Advisory Committee contemplated by the Bill for dealing with the Chinese Indemnity now before Parliament, and by joint committees in China itself

IN the *Electrician* for February 6 some results are given of radio signal measurements between Great Britain and the United States made during the eclipse, which supplement the communication from Dr W H Eccles on p. 260 of this issue The experiments were carried out in Great Britain by the General Post Office, the Radio Research Board, and the International Western Electric Co In the United States the Radio Corporation transmitted special signals from an experimental station situated at Rocky Point, Long Island In Great Britain the Leafield and Northolt stations sent signals Similar observations were made on the day preceding and the day following the eclipse Measurements were made both of the intensity and the apparent bearing of the signals On the day of the eclipse, there was a well-defined rise to a very sharp maximum of the signal intensity This was followed by an equally well-defined minimum The rise corresponded approximately to the intersection of the path of the beginning of the eclipse with the great circle passing through the transmitter and the receiver The minimum of signal intensity coincided to within one or two minutes with the intersection of the path of totality with the corresponding great circle The radio bearings of Rocky Point were observed at Slough on January 24 and 25 and were found to be very steady in each case There was no appreciable effect that could be attributed to the eclipse Observations were also carried out at Slough on the signal intensity and bearings of Leafield, which is distant 48 miles In this case the erratic behaviour of both measured quantities was very marked These variations are a normal daily occurrence at this period of the year and neither of the measurements seemed to be affected by the eclipse

THE Wireless Telegraphy and Signalling Bill which has been introduced in the House of Commons by the Postmaster-General, Sir William Mitchell-Thomson, is a measure of such questionable quality and scientific detriment that it is scarcely likely to pass through Parliament without substantial change The Bill is particularly objectionable from the point of view of the scientific investigator and inventor, as by it officials from the Post Office may demand, under heavy penalties, to enter any laboratory and inspect apparatus and experiments even though these do not involve any outside transmission True, this oversight of experimental work is claimed already as being in departmental regulations, but these could never be upheld The new Bill, however, would make it possible for the Postmaster-General to impose them on any experimenter or inventor What the Bill provides for specifically is control of "the installation and working of apparatus for utilising etheric waves as they apply to the installation and working of apparatus for wireless telegraphy" Mr A A Campbell Swinton points out in a letter in the *Times* of February 17 that a candle or any other source of radiation is producing "etheric waves" and that, as the existence of the ether itself is now questioned in certain scientific circles, much interesting litigation might be anticipated if the words now in the Bill are retained without statutory qualification So many objections have, however, been raised to some of the clauses, as they stand at present, that the measure must meet with considerable opposition when it is under discussion in Parliament

WE have received from Prof G Friedel, of Strasbourg, a somewhat lengthy communication in which he maintains that his classification of Lehmann's so-called liquid crystals is valid He calls this state of matter "mesomorphic" and so early as 1911 recognised that this embraced two distinct forms which he then called "liquides à conique" and "liquides à fils" He supposes that in the former there is a kind of periodicity in the sense that the molecules are distributed irregularly in parallel equidistant layers In the latter there is no periodicity at all, but only a general parallel orientation of the molecules These valuable conceptions sharply differentiate the mesomorphic states from the complete periodicity of true crystals on one hand and from the complete irregularity of amorphous bodies or liquids on the other In 1922 he re-named the two states "smectique" and "nematique" (from σμῆγμα, soap, and νῆμα, thread, from the thread-like appearance of the sharp boundaries of different portions observed in polarised light under the microscope) He suggests that the English name for the former should be derived from the French rather than that the existing English word "smegmatic" (derived from the original Greek) should be used He differs strongly from McBain in holding that such bodies as soap curds do not consist of crystals but are mesomorphic, and it is for this reason that he no longer uses the designation "liquid" If, as affirmed by McBain (see photograph in NATURE of July 12, 1924, p 49), there is at least one other form of soap which may be described as a "conic anisotropic liquid," this would merely show that the same body can exist in several different "smectic" forms This, however, leaves scope for speculation as to how to explain these different varieties

ALTHOUGH a number of investigators using X-rays have failed to obtain radiograms with any liquid crystals except for soap curds, the classification of which is in dispute, Friedel maintains that this is due to faulty technique in the case of smectic bodies such as transparent soap solutions, whereas no nematic body should give such a radiogram He announces that his son, E Friedel, has now obtained such a radiogram with ethylazoxybenzoate Publication of this evidence will be awaited with interest Friedel appears, however, to be mistaken in his assertion that radiograms of soap curds disclose only one set of planes, Piper (J. Phys Soc, 1923, 35) found three spacings, namely, one wide spacing of the order of 4Å and two of the order of 4Å. R E Gibbs (J Chem Soc, 1924, 125, 2625), referring to the higher fatty acids, the X-ray photographs of which resemble the soap curds, remarks. "Owing to the doubt that has existed as to the nature of the fatty acids, it is of interest to note that, since this paper was written, further work has been done with stearic acid showing it to be of a true crystalline nature and demonstrating its extinction directions and brush figures Several single crystal X-ray photographs of it have already been taken"

THREE Cantor Lectures, on January 19, 26, and February 2, were delivered at the Royal Society of Arts on "Radiological Research—A History," by Mr. V E Pullin, Director of the Radiological Research Department, Woolwich Mr. Pullin said that radiological research may be said to have begun in the year 1705 with the experiments by Mr Hawksbee, F R S, on electrical discharges in vacua, followed by those of Mr William Morgan in 1785, the latter probably the first experimenter to produce X-rays The great advance in knowledge made by scientific workers during the nineteenth century, particularly Faraday and Sir William Crookes, paved the way to the sensational discovery of X-rays by Rontgen at the end of 1895 The controversy as to the nature of the cathode stream was eventually settled by the classical work of Sir J J Thomson in 1897 The nature of the X-rays was finally determined when, aided by Planck's theory of radiation, Prof von Laue was able to show that X-rays could be diffracted by means of crystals The accidental discovery of X-rays by Rontgen in 1895 was due to his use of fluorescent screens Much important research during the next crowded years resulted in Sir Herbert Jackson's use of a concave cathode, Mr Campbell Swinton's platinum target, and the introduction of the vacuum regulators gave us the modern gas-tubes, leading up finally to the introduction in 1913 of the Coolidge tube To-day it is possible to operate a tube on 200,000 volts and to examine castings 3 in thick Voltages up to 400,000 are already available at Woolwich, but no X-ray tube can stand up to more than 200,000 volts owing to vacuum and other difficulties These difficulties may call for a new type of tube, and research on this subject is now being carried out at Woolwich Modern research is also being directed on the problem of focussing, and design of very high tension direct current electrical machines Radiology should be the indispensable adjunct of all modern engineering practice, owing to the great saving that can be effected by detection of flaws in heavy castings, before expensive machining has been done During the previous week, with some new apparatus, designed and made at Woolwich, a mass of steel 4 in in thickness was penetrated This constitutes a record in penetration

DR. J H JEANS, secretary of the Royal Society, and Sir William Henry Ellis have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

SIR WILLIAM HARDY and Miss Ida Bircumshaw will deliver the Bakerian Lecture at the meeting of the Royal Society of March 19 They will take as their subject "Boundary Lubrication Plane Surfaces and the Limitations of Amontons' Law"

THE Council of the Chemical Society has nominated Dr Arthur W. Crossley as president, Dr T Slater Price as secretary, and Prof F G Donnan as foreign secretary. The annual general meeting will be held on March 26 at 4 P.M, and the anniversary dinner will be held the same evening at the Hotel Victoria, Northumberland Avenue.

SIR THOMAS H HOLLAND has been elected president, and the Rt Hon Viscount Cowdray of Cowdray, Sir John Cargill, Bart, Mr Alfred C Adams, Mr Alexander Duckham, Mr Arthur W Eastlake, and Mr Robert Redwood have been elected vice-presidents of the Institution of Petroleum Technologists for the ensuing year

THE International Health Board of the Rockefeller Foundation has made a grant of 1,100,000 krone (about 62,000*l*) to the Danish State Serum Institute at Copenhagen for the purpose of extending the building and laboratories This is the third grant made to Denmark by the Rockefeller Foundation during the last year or two Previous grants were allocated to the Veterinary School and to Prof Niels Bohr

THE following officers of the Royal Astronomical Society were elected at the anniversary meeting on February 13 *President*, Dr J. H Jeans, *Vice-Presidents*, Dr A C D Crommelin, Dr J L E Dreyer, Prof A Fowler, Dr J W L Glaisher; *Treasurer*, Lieut-Col F J M Stratton, *Secretaries*, Dr J Jackson, Rev T. E R Phillips, *Foreign Secretary*, Prof H H Turner

ON Thursday next, February 26, at 5 15, Sir Arthur Smith Woodward will deliver the first of two lectures at the Royal Institution on dinosaurs, and on Saturday, February 28, at three o'clock, Sir Ernest Rutherford will begin a course of four lectures on the counting of the atoms The Friday Evening discourses on February 27 and March 6 will be delivered by Sir James Irvine, on sugars from the point of view of the organic chemist, and by Sir Arthur Keith, on the rate of man's evolution, respectively

AT the annual general meeting of the Meteorological Society on January 18, the following officers were elected *President*, Mr C J P Cave, *Vice-Presidents*, Dr C Chree, Mr J S Dines, Mr L F Richardson, Mr Gilbert Thomson, *Treasurer*, Mr Francis Druce, *Secretaries*, Mr Richard Corless, 21 Wimborne Gardens, W Ealing, W 13, Commander L G Garbett, Meteorological Office, Air Ministry, Kingsway, W C 2, Major A J H. Maclean of Ardgour, Ardgour, Argyllshire, *Foreign Secretary*, Mr R G K. Lempfert, 24A Trebovir Road, S W 5, *Assistant Secretary*, Mr A Hampton Brown, 49 Cromwell Road, South Kensington, S W 7

THE discovery of a new urinary antiseptic by the Johns Hopkins School of Hygiene and Public Health is announced in the *Times* of February 12. Hexylresorcinol, as the new compound is named, is the outcome of several years' work by Dr Leonard, of the National Research Council, in collaboration with Dr Treat Johnson, professor of organic chemistry in Yale University It is stated to be a potent antiseptic for the treatment of infections of the kidneys and urinary tract, long-standing infections of the kidneys clearing up under its use in 48 hours The cures appear to be permanent, and no ill effects were observed

THE Royal Society has now been notified that His Majesty's Treasury proposes to make provision in the Estimates for 1925–1926 for an increase of the Royal Society Publication Grant from 1000*l* to 2500*l* in the current year This grant is available for helping the publications of other scientific societies as well as for assisting the separate publication of books, memoirs, etc, of a scientific nature Applications for grants for the current year will be considered by the Council of the Royal Society at its meeting early in July Applications from societies will be received by the secretaries of the Royal Society, those from individuals should be brought forward by members of Council

Two noteworthy gifts, for research and for education, are announced by the New York correspondent of the *Times* A fund of 600,000*l* has been raised for the establishment at Johns Hopkins University of a centre for ophthalmological research to be called the Wilmer Institute The General Education Board has given half the money and the remainder has been subscribed by friends and former patients of Dr William Holland Wilmer, of Washington, who will retire from private practice to assume direction of the new centre The other announcement is of a gift of 100,000*l*, by Mr Cleveland H Dodge, of New York, to the fund for the Near East Colleges The institutions which benefit by the gift are the Robert College, Constantinople, the American University of Beirut, the Constantinople Women's College, and other institutions at Smyrna and Sofia The gift is sufficient to cover a fifth of the working expenses of the colleges for the next five years

A MEMORANDUM on the probable character of the weather in north-west India in January, February, and March has recently been issued by Mr. J H Field, the officiating Director-General of Observatories for the Government of India. The forecast states that "the winter rainfall of north-west India together with the snowfall on the western Himalayas may be expected to be normal or in slight excess." These winter rains are brought by a series of depressions from south-west Europe and the Mediterranean The tendency for persistence in the winter affords indication for the later months to be based on the weather in December. The application of statistical methods to seasonal forecasting in India has been very definitely studied, and with considerable success In addition to the factors which have been in use for some time past, another feature which seems likely to prove of importance is the seasonal change of the upper air currents in northern India at a height of 4 miles above ground obtained from observations at Agra

THE report of the Council of the Optical Society submitted to the annual general meeting of members on February 12 shows that the efforts of the Society to promote and advance the theory and practice of optical science are being well maintained. The steadily increasing interest that is being taken in this subject is evidenced not only by the nature and number of the papers presented to the Society, but also by the interest taken in the Society's Transactions, in which these papers are printed. By means

of special exhibits and demonstrations at recent meetings, attention has been directed to instruments and apparatus of historic interest as well as to modern developments of various optical instruments The financial position is now so satisfactory that a further extension of the Society's activities is under consideration The following officers have been appointed for the current session *President*, Mr T Smith, *Vice-Presidents*, Instr -Comdr T. Y. Baker, Prof Archibald Barr, Sir Frank Dyson, *Hon Secretaries*, Mr F F S Bryson, Prof A F C Pollard, *Hon Treasurer*, Major E O Henrici, *Hon Librarian*, Mr J H Sutcliffe, *Editor*, Dr J S Anderson

"TAKING a Museum to School" is the heading of an article in the *Manchester City News* of February 7 It describes a scheme which has been inaugurated by the Salford Museum for the distribution to schools of portable cases containing natural history specimens, photographs of trees, types of architecture, furniture, etc The underlying principle is sound though by no means new The idea has been greatly elaborated by the American Museum of Natural History, and in 1922, 475 schools were supplied with sets Of course, in a large museum where the staff is adequate, or when there are official guide lecturers, it were better to bring the classes to the museum When such is not possible, then exhibits may, with great advantage, be sent to the school The cases thus supplied may show birds, animals, and so on, which children would not otherwise see, and may encourage them to visit the museum itself and so extend their knowledge But the great difficulty is the "text" accompanying the cases Such exhibits placed in the hands of teachers having no special knowledge of the subject may tend to grave misconceptions, whereas a stereotyped lecture may become irksome Children have a way of asking peculiar questions. Before receiving such cases the teachers should have a "lesson" themselves, given by the person responsible for the exhibit

ON February 26 occurs the bicentenary of the birth of Nicolas Joseph Cugnot, the French military engineer who built the first vehicle driven by a steam engine Born at Void in Lorraine in 1725, Cugnot joined the French army, served in the Low Countries, and afterwards in Paris gave lessons in military affairs In 1766 he published his "Éléments de l'art militaire ancien et moderne" and three years later a volume on fortification He appears to have made two steam vehicles, the first in 1769 and the second in 1770 The earlier was put into motion in the presence of the Duc de Choiseul, then Minister of War, and of General Gribeauval, and it carried four persons Its steaming capacity, however, was very small, and it had to stop at short intervals to allow the steam pressure to rise The demonstration led to the construction of a second vehicle at the Paris Arsenal, and this is now preserved in the Conservatoire des Arts et Métiers It is doubtful if this vehicle ever ran Intended for the transport of artillery, it was designed to carry a load of about $4\frac{1}{2}$ tons at a speed of $2\frac{1}{4}$ miles per hour and cost 800*l* Though designed by Cugnot it was made by Brezin General Morin in 1851 gave an interesting account of the machine to the Paris Academy of Sciences Cugnot continued to reside in Paris until the Revolution, when he went to Belgium Poverty appeared to have dogged his steps, but under the Consulate he was given a small pension of 1000 livres, and he returned to Paris, where he died on October 4, 1804

IN a discourse delivered before the Royal Institution on February 13 on the forces of law and order in a primitive community, Dr B Malinowski gave an account of his conclusions in regard to primitive law arrived at during his years of field-work among savages in Melanesia In his opening remarks he referred to the Imperial value of anthropological studies for the government of savage races, and said that such studies must be directed to the actual and practical problems of savage life in order to be useful The real task of the administrator is legislation and the meting out of justice to the natives, and the most important practical subject of anthropology should be primitive jurisprudence Upon this question anthropology hitherto has often been silent and sometimes even incorrect Nothing could be more misleading than the statement frequently made that "all societies have passed through a stage of communal ownership and communistic sexual relation" Taking Melanesia, Dr Malinowski showed that, in spite of most illusive appearances, the ownership of property is strictly defined and there is no trace of real communism The so-called communism is the result of the observers looking at native custom through European eyes Another legal dogma constantly used by some modern anthropologists is "The clan or kin is the unit in primitive law and not the individual" Exogamy is usually quoted as the most perfect index of the homogeneity of the clan This again is an illusion Dr Malinowski urged that it is in this type of anthropological analysis of savage institutions that the anthropologist can join hands with the administrator in working out a practical science of administrative anthropology

ARRANGEMENTS are in progress for the next annual meeting of the British Association, to be held in Southampton on August 26-September 2, under the presidency of Dr Horace Lamb, formerly professor of mathematics in the University of Manchester Presidents of the several sections have been appointed as follows *Mathematics and Physics*, Dr G C. Simpson, director of the Meteorological Office; *Chemistry*, Dr C H Desch, professor of metallurgy in the University of Sheffield, *Geology*, Prof W A Parks, of the University of Toronto, *Zoology*, Mr. C Tate Regan, keeper of zoology in the British Museum (Natural History), *Geography*, Mr A R. Hinks, secretary of the Royal Geographical Society; *Economics*, Miss Lynda Grier, principal of Lady Margaret Hall, Oxford, *Engineering*, Sir Archibald Denny, Bart, *Anthropology*, Dr Thomas Ashby, director of the British School at Rome, *Physiology*, Dr A. V. Hill, professor of physiology in University College, London, *Psychology*, Dr C. E. Spearman,

Grote professor of the philosophy of mind, University of London, *Botany*, Prof J Lloyd Williams, of University College, Aberystwyth, *Education*, Dr W W Vaughan, headmaster of Rugby, *Agriculture*, Dr. J B Orr, head of the Rowett Research Institute, Aberdeen Among the principal items already set down for discussion are transport problems, to which the Sections of Economics and Engineering will devote two days, with special reference to the railway centenary of the present year, the cost of farming and the marketing of agricultural produce (Sections of Economics and Agriculture), the functional significance of size (Zoology and Physiology), the ignition of gases (Chemistry and Engineering), tidal lands (Geography and Botany), variations in gravitational force and direction (Physics and Geology), recent investigations upon vocational guidance (Psychology and Education), the distribution of animals and plants in relation to continental movements (Geology, Zoology, and Geography), the acquisition of muscular skill (Physiology and Psychology), and discussions on health in schools, the disciplinary value of subjects, the training of teachers, and the teaching of biology. Prof Parks, of Toronto, as president of the Geological Section, succeeds the late Dr Willet G Miller, the Ontario Government mineralogist, who was to have occupied the chair of the Section

WITH the January number the *Illuminating Engineer* begins a new stage of its existence Formerly it was merely the official organ of the Illuminating Engineering Society, it has now been extended so as to appeal to a much wider class of reader This number is brightly written and shows that good methods of illumination are of general interest During last year no very striking progress was made in inventing new lamps or incandescent mantles, but considerable progress was made in the methods of applying illuminants It is considered that the time has come to enlighten the public as to what is being done Playing games by artificial light, lighting developments at the Zoological Gardens in Regent's Park, the psychology of illumination, lighting and tobacco, inadequate lighting and defective vision, illuminated name plates for motor cars, and artistic illumination are only a few of the subjects discussed We were specially interested in the "possibilities and limitations" of motor-car headlights It is pointed out that the glancing beam of the headlight does not show to the driver puddles of water in the road During the floods of December, inability to locate fairly deep water ahead often proved embarrassing This shows that headlight illumination is far from perfect

IN our issue of February 14, p 242, reference was made to an article by Mr F W Shurlock on the Rev A Bennet, F R S, in the January number of *Science Progress* Mr Shurlock writes to point out that the statement that Bennet died at Fenny Bentley is inaccurate He held the rectory of Fenny Bentley concurrently with the curacy of Wirksworth, where he lived, died, and was buried, a memorial tablet is in the church, on the south wall of the nave

AN assistant is required in the new chemical laboratory of the City Analyst for Leicester The work of the person appointed will be mainly in connexion with the analysis of food and drugs, water and sewage effluents The latest date for the receipt of applications by the Medical Officer of Health, Leicester, is Thursday, March 5

ERRATUM—In NATURE of February 14, p 236, column 2, line 46, for words "that is" read "at all events"

Our Astronomical Column.

THE LUNAR ECLIPSE OF LAST AUGUST—*C R Acad Sci* of Jan 19 contains a research on the brightness of the moon at this eclipse, made by J. Dufay and A Conder at St Geniez (height 3500 ft) in a clear sky They used the Dufay photometer, which gives results that are independent of the diameter of the body measured The moon was compared with Mars and Jupiter, the magnitudes of which were taken as -2 6 and -1 8 In the following table D is the distance in minutes of the moon's centre from the centre of the shadow, V its visual and P its photographic magnitude, C the colour-index

D	V	P	C	D	V	P	C
10′	$-0\ 9^m$	m	m	18′	$-1\ 35^m$	$+0\ 7^m$	$2\ 05^m$
12	−1 0	+3 2	4 2	20	−1 65	0 0	1 65
14	−1 1	+2 3	3 4	22	−2 1	−0 7	1 4
16	−1 2	+1 4	2 6	24	−2 7		

The increase of red in the centre of the shadow is very noticeable, and was also observed in the telescope, the outer portion of the umbra being greenish grey, the next zone orange-red, the centre brownish red

The colour-index of Mars was determined as $1\ 37^m \pm 0\ 06^m$ It presumably varies with the character of the markings on the disc at the time

Comparison was made with the eclipse of Oct 16, 1921, observed by M Danjon It was concluded that the moon in 1921 was four times as bright as in 1924, presumably owing to greater cloudiness in the earth's atmosphere in 1924

ASTROGRAPHIC ZONE 21° SOUTH (HYDERABAD)—The Hyderabad Observatory (Director, T P. Bhaskaran) has shown most praiseworthy zeal and energy in completing not only the zone originally undertaken but also the zone −21° to −23°, which had been undertaken by two other observatories in turn, but abandoned by both of them It was thanks to the liberality of the Nizam and his Government that this extension was possible The present volume contains the measures of stars on the plates the centres of which are in declination 21° south The average number of stars per plate is 491, a higher average than in previous zones, this is ascribed to improvement in the quality of the plates Plates were rejected that did not show at least twice as many stars as Schonfeld's map In the galactic zones, some fifteen times as many stars are measured as are contained in the map, although the measurers were instructed to pass over the very faint stars in these regions

The catalogue contains the measured diameters, with data for deducing the magnitude, and the *x*, *y* co-ordinates to 3 decimals of a réseau interval, also provisional plate constants for reducing to R A and decl The plates in the present volume were exposed between Dec 1920 and June 1923

Research Items.

PSYCHO-ANALYSIS AND MOTHER-RIGHT —In *Psyche* for January, Dr B Malinowski concludes his examination of the applicability of the Freudian theory of the Œdipus complex to a society organised on a matrilineal basis In his previous contribution to this subject (*Psyche*, April 1924) it was shown that whereas under the *patria potestas* the conflict is concerned with father and mother, in the matrilineal family of the Trobriands, it affects the sister and the mother's brother Turning now to the question of disease and perversion, it appears that among the Trobrianders, where sexual desires are allowed a natural outlet at an early age, perversions and neurotic affections are comparatively rare, while in the Amphletts, where sexual license is repressed, they occur with frequency The evidence of dreams, distinguishing "free dreams" from "official dreams" of a divinatory or magical character, points to repressed desire in the direction of the sister This form of incest is regarded with such horror that at first sight it might appear never to occur, but careful investigation has revealed that it does exist Both obscenity and myth bear this out Abuse by attribution of mother and sister incest, though both actions are abhorrent to the Trobriand mind, in the degree of resentment it arouses indicates that there is a real temptation to break the strong taboo against the sister In the same way, throughout the myths of the Trobrianders there runs a strong matrilineal complex, in the tales of origin, no father appears, and when a male member of the family is mentioned in such a manner as to indicate a conflict of some kind, it is the maternal uncle

THE PROBLEM OF ARISTOTLE —Prof Burnet's British Academy "Master-mind" Lecture ("Aristotle," Oxford University Press, 1*s*) is of more than usual interest, not only to classical and philosophical students but also to men of science Aristotle's real greatness, Prof Burnet tells us, was as a biologist The most important formative period of his life was the middle period, the years when he was lecturing at Assos and afterwards when he removed to Mytilene in Lesbos, where he made his careful observations and studies of marine forms of life Prof Burnet refers to the recent important work of Prof Werner Jaeger of Berlin ("Aristoteles, Grundlegung einer Geschichte seiner Entwicklung") The conclusions of this book are in accord with Prof Burnet's own independent studies of the problem, though he differs from the author on some points of minor importance The curious problem about Aristotle is that scarcely any of the works we possess, and none of the important ones, were published in his lifetime or intended for publication, or in a form in which he would have acknowledged them or consented to their publication Yet it seems certain that they represent his mature views in a way which his published works did not They are his written lecture notes, and they have been preserved by a strange accident, while his own published works, by which alone he was known in the first two centuries after his death, are lost What Prof Burnet brings out with exceptional clearness is that the contrast between Plato and Aristotle and the latter's criticism of the former's doctrine of forms is explained by the fact that, while Plato was exclusively interested in mathematics, Aristotle's attention was directed towards biology.

TERTIARY MAN IN ENGLAND —A review of the evidence bearing upon the question of tertiary man in Britain by Mr J Reid Moir, appears in vol xxiv, No 6 of *Natural History* (American Museum of Natural History) The vast geological age of the Kentian eoliths finds support in East Anglia There the White Coralline Crag, which is definitely earlier than the Red Crag, was laid down in a warm period, the deposition of the Red Crag beginning with the irruption of arctic waters The Red Crag detritus contains material of different periods due to denudation, including eoliths of Kentian type, much rolled and abraded, and later forms of which the rostrocarinate is the outstanding implement The Red, and Norwich Crags, and their underlying detritus bed, represent the first glacial deposit in East Anglia. The Foxhall implements belong to the Crag itself and are clearly later than the detritus bed implements, as is shown in the variation in patination when, as in several cases, the former has been made out of the latter, but implements of the same kind as are found at Foxhall occur at Thorington Hall *beneath* the Crag, where man evidently lived on a surface of London clay instead of Crag The Cromer implements are to be regarded as Early Chellean, a classification supported by the fauna In an appended note in the same publication, Sir E Ray Lankester questions the use of the term "quaternary" to describe the strata later than pliocene, on the ground that they are adequately described as tertiary, as there is no separation of later deposit from pliocene as there is of tertiary from secondary and secondary from primary The term pliocene should be applied to the White Coralline Crag on the ground of its Molluscan fauna in many respects identical with that of deposits distinguished by the marine "Pliocene", while the Red Crag should be assigned to the Pleistocene, it being recognised that the shells, bones, and teeth of cetaceans and terrestrial mammals in the Suffolk Bone Bed, which were assigned by Lyell and his followers to the Red Crag, and its sea are derived from earlier strata and are not contemporary with the Red Crag.

THE PLEISTOCENE VERTEBRATE FAUNA OF NORTH AMERICA —The Carnegie Institution of Washington has published (October 1924) an account, by Dr O P Hay, of the pleistocene vertebrate palæontology of the region west of the Mississippi, a continuation of a previous account which dealt with the regions east and north of the river The volume deals with the discovery of various groups of mammals, each group being taken separately, and the places where species of the group have been found are detailed in order for each province More than a quarter of the account concerns the places where Proboscidea have been found, mastodons and, in particular, *Elephas boreas*, *E columbi*, and *E imperator* Other groups detailed are the Xenarthra, horses, tapirs, peccaries, camels, deer, bison, and beavers Twenty-nine maps illustrate the positions where material has been found, and an index, which is very complete, gives reference both to the animals and their localities The work will be very useful for reference by any one studying the Pleistocene of North America as well as for purposes of comparison with the corresponding faunas of the Old World in questions of migration and distribution

CARBONIFEROUS ROCKS IN CENTRAL JAPAN —A recent issue of the Scientific Reports of the Tôhoku Imperial University at Sendai (vol viii, No 1) contains an important paper by Ichirô Haysaka "On the fauna of the Anthracolithic Limestone of Ômimura in the western part of Echigo" The paper has had a chequered career, originally written in 1920, the MS was destroyed in the Tokyo fire that followed the earthquake of September 1, 1923, and

the whole work has been courageously rewritten since The locality considered lies on the northern side of the Central Island, almost due north-west of Tokyo The formations represented by the thick mass of almost vertical limestone, about 2 km in thickness, there developed probably include the Permian down to the Tournaisian The fossil fauna comprises Foraminifera (including, of course, the well-known Fusilina), corals, Brachiopoda, Bryozoa, a crinoid, and a very few mollusca Altogether, 41 species are recorded, but only four are regarded as new, while several are indeterminate Representative specimens receive illustration on six plates of that standard of excellence which we have come to associate with Japanese productions, whilst there is, further, a map of the district giving the geological details The author points out that the Lower Carboniferous formation of marine origin is almost absent from continental Eastern Asia—China, Korea and Manchuria—although it seems to be recognised in the province of Yun-nan, and has been reported from Central Asia What was the relation between the Lower Carboniferous waters of Central Asia and of the eastern border land is, as he remarks, a very interesting question

CHROMOSOMES OF WHEAT HYBRIDS —Mr A E Watkins (*Journ of Genetics*, vol. 14, No 2) has made an important investigation of the chromosome behaviour in certain hybrid wheats From earlier work of Sakamura, Kihara, Sax and others, the wheats are known to fall into three groups having chromosome numbers which are different multiples of 7 An intensive study was made of the chromosome distribution in the pollen mother cells of F_2 and F_3 plants derived from crossing Rivet wheat (*Triticum turgidum* var $2n=28$) with varieties of *T vulgare* ($2n=42$) The F_1 plants have 35 chromosomes, and two plants from later generations were especially studied, one having 31 chromosomes ($14\times2+3$) and the other 38 ($=17\times2+4$) The history of the unpaired chromosomes is followed and the mathematical probability of the various types of pollen grains which will be formed, based on random distribution, is worked out From these observations and those of Kihara, it is found that plants with less than 35 chromosomes never have more than 14 bivalents, and in plants with more than 35 chromosomes the sum of the number of bivalents and univalents is always 21 One tentative explanation offered is that in these hybrid plants only pollen grains with 14 or 21 chromosomes function There is evidence from other plants that the unpaired chromosomes are frequently or usually lost

THE CARBON BLACK INDUSTRY —A few years ago the carbon black industry of the United States was one of the minor "side-lines" of natural gas production, and some peculiar state legislation very nearly killed it altogether, especially in Louisiana A new demand for this commodity, however, has arisen and has influenced operations to such an extent that the output for 1923 (during which year 138,262,648 pounds were produced) represented an increase of 104 per cent over that obtained in the previous year The cause of this remarkable spurt is the demand by the rubber companies manufacturing pneumatic tyres for motor vehicles, carbon black is thus employed with considerable advantage both to manufacturer and to user Mr G B Richardson, in Mineral Resources of the United States, 1923, part 2, gives figures to show that the average yield per thousand cubic feet of gas is 1 3 pounds of carbon black, and the estimated quantity of gas used for the purpose in 1923 was 109,096,000 thousand cubic feet Louisiana, the most important producer in America, was responsible for practically 75 per cent of the total amount, West Virginia and Kentucky yielding the next largest outputs It is interesting to note, however, that during the latter part of 1923 a state of over-production of this substance was reached, and as this corresponds with a period of great activity in the pneumatic tyre industry, we may gauge to some extent the possible economic limit to the manufacture of carbon black for this purpose and to the expansion of the industry The price of carbon black at the plant averages about 8 5 cents per pound

PHYSICAL CONSTANTS OF ICE —The specific heats and latent heats of fusion of ice have recently been determined by O Maass and L J Waldbauer (J Amer Chem Soc, Jan 1925) The method used enabled measurements to be carried out at low temperatures The specific heat of ice, determined at ten-degree intervals from $-180°$ to $0°$, was found to be accurately represented by the equation $c=0\ 485+0{\cdot}000914t-0\ 00000546t^2$, the latent heat of fusion is 79 42 cal per gram The specific and latent heats of some organic liquids were also determined, the results indicate that atomic heat is a highly constitutive property when the specific heat of a compound varies greatly with the temperature

THE SUN AND ATMOSPHERIC ELECTRICITY —In the March and December 1924 issues of *Terrestrial Magnetism and Atmospheric Electricity*, Dr Louis A. Bauer has collected together and discussed the observations on atmospheric electricity made on undisturbed days during the past seven sunspot periods He concludes that the atmospheric potential gradient and its daily and seasonal variations, and the air-earth electric current, are influenced by sunspots As a rule the gradient and the ranges of its daily and seasonal variations are increased about 30 per cent. by the change from minimum to maximum sunspot frequency, but there have been periods in which they have decreased, and in these periods terrestrial magnetic activity has also decreased The gradient and the ranges of its variation are greatest near the equinoxes and least near the solstices

GUN WIRE —The system of wire-winding of guns first proposed in 1855 was introduced about 1890 with the object of effecting a distribution of the firing stresses in a more uniform way than could be attained by shrinkage alone The steels employed usually contained from 0 6 to 0·7 per cent of carbon, and British gun wire is in the form of a tape or ribbon 0 25 in wide by 0 06-0 04 in thick with rounded edges The steel is severely cold-worked, and exhibits a comparatively low elastic limit in spite of its high tensile strength, but it has long been recognised that this condition of imperfect elasticity in the wire under tension can be removed by a low temperature heat treatment We have received from the Research Department, Woolwich, R D Report No 60 entitled "Gun Wire The Effect of Low Temperature Heat Treatment on the Properties of Cold-Strained Steel and Its Behaviour under Stress at Raised Temperatures" The work described was undertaken with the object of providing a material which would maintain a condition of constant stress with constant strain at a given temperature whatever the variation (within certain limits) of strain and temperature to which it was subjected in use The author, Dr Greaves, as a result of his investigations, concludes that if it is required to ensure a constant tension in the wire at atmospheric temperature, in

spite of considerable variation in the temperatures to which it may be subjected in use, the wire must be heat-treated at a temperature not below 200° C The lower limit of the temperature of preliminary treatment (in excess of 200° C) is fixed by the fact that it must be above any temperature to which the wire is likely to be subjected in use On the other hand, the upper limit of temperature of treatment is governed by the tension which is to be maintained The higher the tension the less must the temperature of the treatment exceed 200° C The report contains data from which the relation between stress, temperature, and preliminary treatment of the wire can be determined

A VECTOR-TROLLEY APPARATUS —Anything that makes the principles of mechanics more obvious to the student is sure of a hearty welcome from all teachers of the subject in schools and at universities Considerable interest, therefore, attaches to the "Vector-trolley" apparatus designed by Mr E J Atkinson, of the Harrow County School, and exhibited recently at the annual meeting of the Mathematical Association, and at the Royal Institution The method is based upon the principle of the well-known problem in mechanics, where two masses, one moving on a horizontal table and the other falling vertically, are joined by a string passing over a fixed pulley The motion is one of uniform acceleration, even if friction and the mass of the pulley are taken into account If in this way motion is given to the mass on the table, and the hanging mass is disconnected from it, then, assuming smooth running, the mass on the table can be taken to move with constant speed for some considerable time. The application of this principle by Mr Atkinson is made clear by means of the accompanying illustration (Fig 1), from which it is seen that two such accelerated or uniform motions in different directions are communicated to a registering instrument simultaneously The angle between the two motions can be adjusted at will. Propositions like the parallelogram of velocities and of accelerations, the relationship $P=mf$, parabolic motion of the projectile, the theory of relative motion, can all be illustrated simply and convincingly Mr Atkinson's method is very straightforward The mechanism is easily understood, and both the teacher and the student should find the use of such a mechanism of considerable value The apparatus is being manufactured by Messrs Cussons, Ltd., of Manchester

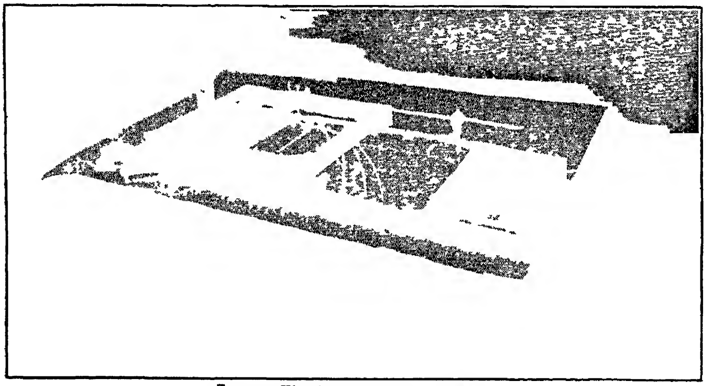

FIG 1.—The Atkinson vector trolley

FORGING TEMPERATURE OF STEELS —It is well known that, in the case of steel, forging is most effective at a certain favourable temperature which is neither too high nor too low This is called the forging temperature As yet no method has been discovered for measuring the forgeability of a metal. Prof Kotaro Honda has addressed himself to this problem, and in the eighty-first report from the Research Institute for Iron and Steel and other Metals, Sendai, entitled "On the Forging Temperatures of Steels," he concludes that forgeability can be adequately measured by the elongation obtained in a testing machine He gives reasons for considering that the mechanism of the elongation due to longitudinal tension and lateral compression must be the same, and finds that, in the case of carbon steels, the elongation temperature curve has generally two maxima and two minima The temperatures of the maxima are at 760° and 1200° C, this latter being the temperature most favourable for forging The temperatures of the minima are at about 900° and 300° Hence in the process of forging low carbon steels, every precaution must be taken against a fall of temperature to 900°, where the elongation is at a minimum In the case of medium carbon steels this minimum is inconspicuous, so that the cooling of the specimen is not so critical The investigation of a high speed tool steel containing 18 per cent of tungsten showed that the elongation temperature curve has maxima at 800° and 1100° and a minimum at 950° The maximum at 1100° is very sharp, and hence in high speed tool steels the temperature range favourable to forging is very limited

ACTIVITY NUMBERS OF HYDROCHLORIC ACID —The activity coefficients and transport numbers of hydrochloric acid solutions in ethyl alcohol are described in two papers by H S Harned and M E Fleysher, published in the Journal of the American Chemical Society for January 1925 The activity coefficient and activity of the acid are about one hundred times greater in alcoholic than in aqueous solutions The cation transport number, determined by measuring the E M F of the concentration cell $Ag/AgCl/HCl(c_1)/HCl(c_2)/AgCl/Ag$, was found to be 0 654 for 0 1N, and 0·610 for N solutions. These figures are in agreement with the results of Lapworth and Partington (1911) Measurements were also carried out in aqueous alcoholic solutions of the acid

MICROSCOPE LAMPS —Several novel and useful types of microscope lamps and illuminating apparatus, suitable for routine work, for micro-projection, and for dark ground and critical illumination, are described in a catalogue recently issued by Messrs Ogilvy and Co from their new address at 20 Mortimer Street, London, W 1 Included amongst these is the Hartridge-Williams axial illuminator This consists of an electric lamp of suitable design enclosed in a ventilated chamber, which can be fitted to any pattern of microscope The illuminator when fitted forms an integral part of the microscope, occupying the usual place of the mirror By its use, errors due to polarisation or double reflection from a mirror are avoided and a light source, invariable in position, shape and character, is obtained No external lamp or bull's eye is required, and adjustments once made are not affected by inclining the microscope or moving it about The illuminator is fitted with an iris diaphragm which limits the area of light on the specimen to the field of the eyepiece

Chemistry in India.

DR M O FORSTER, in his address to the twelfth Indian Science Congress, has preached a sermon which is not likely to be forgotten by those who were privileged to hear it or by those who have had an opportunity of reading it Phrased in the happy manner which came to many as a revelation on the occasion of his address to Section B of the British Association at Edinburgh, it deals with numerous fundamental and intimate questions which are exercising the minds of many thoughtful men and women at the present time Probably no one can do this kind of thing quite so well as Dr Forster, for he enhances his constitutional optimism by a flow of language which overwhelms the pessimist and carries the reader from the start to the finish along a smooth stream of pleasing rhetoric, past a countryside replete with all that is beautiful and satisfying, only dallying here and there to point out to the traveller some piece of Nature's handiwork more entrancing than the rest, or pausing to express a feeling of admiration for the manner in which scientific man has acquitted himself It is only afterwards that the reader, whose mind, after his journey, will be in a pleasant condition of altruistic confusion, will wonder what it is all about If he is an incorrigible pessimist, and wishes to retain his sanity, he will be well advised to let the first impression stand and not to examine more closely into the nature of the raw material from which Dr Forster has woven his fascinating fabric If, like most of us, he is a man of the world without any unhealthy bias towards extreme optimism or extreme pessimism, but, taking things much as he finds them, bestows neither premature praise nor expresses hasty condemnation, he will find much with which he can agree and a great deal to inspire thought and contemplation

To Dr Forster's audience the address should be of inestimable value, for India needs scientific stimulation and inspiration far more than any other country of her importance in the world Her immense natural resources and the mental calibre of her races ought to ensure her a foremost place, both scientifically and commercially, among the nations, yet she remains chained and fettered, and probably only one in a million of her inhabitants will be in a position to take to heart the message Dr Forster sends them Nevertheless, conditions are changing for the better, and the past twenty years have marked a notable advance in the scientific status of the Indian Empire

The far-sighted vision of an exceptional man led to the founding of the Indian Institute of Science at Bangalore, but it was not until eleven years after the inception of the scheme that all difficulties were removed and the vesting order was signed Meanwhile, the first director, Dr. M W Travers, had been appointed and had drawn up the necessary plans for the organisation and equipment of the new Institute It is undoubtedly due to the devotion and, indeed, self-sacrifice of Dr Travers that the scheme assumed definite shape, and that the buildings and laboratories were ready to receive the first students in July 1911 Slight changes in the original organisation were afterwards made, and at the present time there are three chief departments, namely, those of electrical technology, general and organic chemistry, and biochemistry, there is, moreover, a large central building in which the offices and library are housed, the excellence of the latter being due to the organising ability of Mr C F H Tacchella After the retirement of Dr Travers in 1914, the post of director was held by Sir Alfred Bourne until 1919 when, after Dr Alfred Hay had acted as officiating director for two years, the present holder of the office, Dr M O. Forster, was appointed

It was probably inevitable that, during its earlier years, the Institute should have devoted itself to many *ad hoc* problems arising out of the then existing conditions of Indian manufactures The intention of the founder had been to establish a post-graduate university institution having for its particular object the promotion of advanced study and original research, with special regard to the educational and economic interests of India, but, at that time, advanced education in India was not in a condition to supply a sufficient number of properly trained post-graduate students, and, in those early days, it must have been exceedingly difficult to find the right men to carry out the fundamental research upon which to base the many important industries of the country. Still, in the efficient hands of Dr Sudborough, Dr Fowler, Dr Watson, and Dr Hay, much was done, and the early record of the Institute bears witness to the fact that, despite the obvious difficulties, the research work accomplished supplied material for the improvement of many industries which had hitherto been built on the rule-of-thumb and traditional methods so characteristic of Indian manufacturing procedure as a whole

The appendix to the fifteenth annual report of the Council of the Institute, dated 1924, is now to hand, and it is evident, from the comprehensive list of investigations which the report shows are being carried out by the three departments already mentioned, that important research work of a fundamental character is being pursued The lists are indeed pleasing to read and will stimulate Indian graduates to enter the Institute in order to obtain that training in research methods which not only broadens the outlook, but, without which, it is useless for any chemist to hope to achieve real success in industrial work. For knowledge derived from lectures and books cannot supply the vision, the independence of thought, and the honesty of purpose which are essential to the development of the scientific soul, and Indians would do well to learn the lesson some of their confrères in the west find difficult to assimilate, which is embodied in the address given by Dr Forster at Benares

JOCELYN THORPE.

Local Natural History in Great Britain.[1]

LOCAL scientific societies have their distinct and special place, with its incumbent responsibilities in the scientific life of the country, and it is well that this important fact should not be overlooked, particularly by the societies themselves These, it is to be feared, do not always appreciate their obligations to organise and carry through schemes of scientific work which obviously come within their province. Intensive investigations, both systematic and ecological, of the fauna and flora of the country are problems pre-eminently suited to the activities of local societies In fact, it will be only by the active co-operation and organisation of such societies that

[1] The North Staffordshire Field Club Transactions and Annual Report, 1923–24
The South-Eastern Naturalist, being the Proceedings and Transactions of the South-Eastern Union of Scientific Societies for 1924
The Liverpool Geological Society Proceedings, vol 14 Part I, session the sixty-fifth, 1923–24

it will ultimately be possible to complete our knowledge of these matters

It is, therefore, with particular pleasure that we direct attention to Mr L A Carr's paper on "The Ichneumonidæ of the Lichfield District, Staffordshire," in the first of the three volumes of annual reports and transactions here noticed, as an admirable example of the kind of work which can and should be attempted by all local societies

In the course of only eight years' intensive and constant work, Mr Carr has collected and identified no fewer than 1255 species of this difficult and much neglected group of insects We do not overlook the work of Mr Claude Morley and other isolated workers in this field, but obviously the few experts available in Great Britain cannot be expected to cover the whole ground unaided, even if the exigencies of time and expenses for travel could be met Responsible local workers, like Mr Carr, are required for all branches of zoology and botany, who, by their own enthusiasm, or aided by the organisation of their local societies, will make themselves responsible for one small part of the field of natural history in the immediate neighbourhood in which they live, and by care, patience, and steady work gradually get together the necessary data from which a true and accurate knowledge of the British flora and fauna can be obtained. Mr Carr's paper is abundant evidence of the need for such work No fewer than 335 species in his list are recorded from the British Isles for the first time, and sixteen of the species are new to science. Mr Carr has had his identifications confirmed and his material examined not only by Mr Morley but also by Profs Habermehl and Schmiedeknecht and other leading authorities on the continent. His list is thus authoritative and forms a very valuable contribution to British zoology Research of this kind is being done widely throughout Great Britain, but we would especially plead for more co-ordination and co-operation in such work by the local societies and urge upon them the example of Mr Carr's work

The smaller and less wealthy local societies have received much encouragement and stimulation by their affiliation to form larger bodies, of which the Yorkshire Naturalists' Union is so splendid an example This and other similar bodies, like the recently formed Union of South-Western Societies, the South-Eastern Union of Scientific Societies, the Lancashire and Cheshire Fauna Committee, and the Faunal Survey of Glamorgan, are attempting to systematise research among affiliated societies and to carry it out on the broad lines suggested above We should like to see this principle of larger unions extended to embrace the whole country, so that with the local societies affiliated to their proper union, and the unions in turn affiliated to one or other of the scientific societies in London, or, as now, to the British Association, a complete organisation would be brought into being for the thorough co-ordination of the work of local societies

The unions perform another and perhaps equally important function in bringing the results of scientific research before the general public of the areas they represent, by holding annual congresses at which leading men of science deliver addresses on the special subjects of their own work The annual volume issued by the South-Eastern Union of Scientific Societies for 1924 gives an account of its annual congress held at Guildford last year, at which Sir Richard Gregory presided and delivered an inspiring address on "Science in Civilisation," in which he sought to revive the belief in the power of science to promote spiritual and material progress and to plead for the fuller recognition of what it has done for the benefit of man Among the sectional addresses delivered at this congress may be mentioned "Evolution and Eugenics," by Dr A F Tredgold; "The Educational Value of Regional Survey," by Sir F G Ogilvie, "Some Remarks on Adaptation," by Dr A B Rendle, and "Modes of Protection in the Pupal Stages of Butterflies and Moths," by Prof E B Poulton

It is impossible to estimate the value or to overemphasise the importance of the work which the larger unions are doing by this means A direct link is established between the local societies and scientific workers of the first rank, and the stimulus which the former receive as the result of this contact must largely influence their members and encourage them in the work they are seeking to do

From the same report we learn of another branch of work which the South-Eastern Union is endeavouring to do, namely, the compilation of a card catalogue of all faunal records for the area, with full notes of all localities. Such bibliographical work is important and useful, and we are glad that the Union, as well as other similar bodies, is alive to the necessity of doing it

An admirable example of the work done by a local society in one special field is provided by the first part of vol 14 of the Proceedings of the Liverpool Geological Society here noticed The seven papers which go to make up this volume include the results of original research by members of the Society, and four of them deal exclusively with aspects of local geology, to the elucidation of which they form a most valuable contribution

The three publications under notice give ample evidence of the importance and real value of the work of the societies publishing them. They are representative of the work carried on by kindred societies all over Great Britain, and they provide a splendid example to others of the results which can be obtained by organised research, and the scope of the research which local societies can profitably and creditably pursue

Artificial Incubation.

TWO articles on "The Scientific Principles of Artificial Incubation," by Mr Llewelyn B Atkinson, which are of interest to biologists and physicists and of considerable importance to the poultry farmer, have appeared in the Journal of the Royal Society of Arts, November 28 and December 5, 1924

In Egypt, China and Malay, natural methods of hatching have been replaced successfully by artificial for thousands of years, but among Western peoples the problem of artificial incubation was only solved so late as 1882, when Hearson produced his incubator with a capsule temperature regulator The Chinese plan is described in "Farmers of Forty Centuries" by Prof King of the University of Wisconsin, and it is claimed that with this apparently crude method 95 to 98 per cent of the fertile eggs are hatched. By the Egyptian method described by Capt Cadman at the Harper Adams Poultry Conference, 1923, 85 to 90 per cent of the fertile eggs are hatched Using modern European and American incubators, there is an all-round hatching efficiency not greatly exceeding 55 per cent of the fertile eggs, though there are plenty of hatches up to 85 to 90 per cent It is accepted that incubator-hatched chicks compare very unfavourably with those reared by the mother hen, and that the troubles attendant on artificial incubation do not end with the hatching

Mr. Atkinson sets himself the task of finding why it is

that with far more delicate arrangements than a hen provides, the results obtained by the use of the incubator do not always equal those given by the sitting hen He concludes that an incubator which will do all that the best hen does and do it regularly and with certainty, is a perfectly realisable instrument He gives very full details of the physical and biological factors involved in incubation, drawn largely from the results of his own experimentation, and the conditions underneath the sitting hen are compared in detail with those that exist within the various types of standard incubators The outstanding conclusions at which he arrives are that practically every type of incubator has the air too dry, that the average temperature of the eggs in an incubator is much more regular than in a hen's nest, and that, whereas in modern incubators the whole of the egg is nearly of the same temperature, the temperature of the top being only slightly different from that of the bottom, in the hen's nest the difference between the temperature of the hen's body in contact with the egg and the temperature of the lower surface of the egg is between 14° and 20° F

From these observations the author concludes that the secret of successful incubation lies in keeping the upper surface of the egg hot and the lower surface relatively cool This object is attained by covering the upper surface of the eggs with a very thin sheet of india-rubber The use of this in a hot water incubator, in which the heat reaches the eggs by radiation, is rendered extremely difficult by the fact that the temperature of the tank has to be raised to a most inconvenient degree In the case of the hot air type of incubator, however, it is quite simple to get a difference of 14° F between the top and the bottom of the egg by the use of this rubber sheet It was found also that with this method rapid evaporation of moisture was prevented and that, in fact, the amounts of moisture and carbonic acid around the eggs were nearly those present in a hen's nest Using this method, an incubator which previously had rarely given more than 55 per cent hatched more than 95 per cent of the fertile eggs It is to be noted that the application of heat to the eggs is by direct contact and conduction instead of by radiation or convection Every egg becomes its own regulator, controlling the passage of the heat from the upper surface of the egg to the cooler under surface Mr Atkinson states also that the chicks emerging from an incubator provided with this rubber sheet are far more viable

The Blue Whale.

MR. GERRIT S MILLER'S paper, "Some hitherto unpublished photographs and measurements of the Blue Whale" (Proc U S Nat Mus., Vol 66, pp. 1-4, Pls 1-ix) is a welcome contribution to the literature of Cetacea In spite of its predominating importance to modern whalers, the blue whale (*Balænoptera musculus*) is still imperfectly known, particularly with regard to cranial characters Mr Miller publishes specially good figures of the skull, the rostrum of which has not suffered from the warping which commonly occurs on drying He informs us that the specimen (Washington Museum) was an adult male, 75 feet long, captured off Newfoundland in 1903; but it may be remarked that the free condition of the distal epiphyses of the radius and ulna figured in Pl viii is evidence that the animal had not completely passed the adolescent stage of Flower, and that in any case 75 feet is a small measurement for a really adult blue whale. The digits shown in the same figure appear to be too straight, and the hand is probably a reconstruction of a disarticulated flipper, as indicated by the fact that the numbers of the phalanges are low as compared with other records

Mr Miller makes no comparisons, and his facts must speak for themselves With regard to the skull, the rostrum deserves special notice, its sides being parallel in its posterior half, then converging in a gentle curve to the tip,—in striking contrast with the triangular, straight-sided rostrum of the fin whale (*B physalus*) The premaxillæ are noticeably parallel behind, instead of being arched outwards The postero-internal processes of the maxillæ are long, the orbital plates of the frontals diminish greatly in diameter in passing outwards, and the nasals are stout and broad The palatines have parallel sides, and in the side view the straight outer edge of the maxilla and the outline of the vertex are other features in which this skull differs from that of a fin whale Excellent figures are given of the atlas, axis, sternum, pelvic bones and scapula, the last showing the restored cartilaginous parts As bearing on the great variability of the bones in the larger Cetacea it may be noticed that the sternum differs conspicuously from those figured by True in 1904, as well as from that of the Longniddry whale described by Turner The long series of measurements of bones will be valuable as material for comparison with southern blue whales, the identity or otherwise of which with the northern species it will be the special object of the *Discovery* expedition to investigate S F H

University and Educational Intelligence.

BRISTOL —A research assistantship is open at the Merchant Venturers' Technical College to candidates with an honours degree in engineering Applications should be made to Prof A Robertson at the College

CAMBRIDGE —Mr Arthur Berry has been elected vice-provost of King's College A new post of assistant director of magnetic research at the Cavendish Laboratory, without stipend from the University, has been established for Dr P Kapitza, Trinity College

By a recent vote of the Senate, the University is to ask the Commissioners to remove from the statutes the paragraph under which certain holders of official positions, such as bishops, heads of house, and privy councillors, can at present be granted degrees *honoris causa* in virtue of the positions that they occupy University and college teachers and officers are still to be eligible for the degree of Master of Arts, and the University retains its powers to grant honorary degrees to members of the Royal Family, to British subjects who are of conspicuous merit or have done good service to the State or to the University, and to foreigners of distinction

Dr Haddon is resigning from the readership in ethnology

The vice-chancellor, Dr Fitzpatrick, president of Queen's College, Dr Giles, master of Emmanuel College; Mr F J M Stratton, Gonville and Caius College, and Mr R E Priestly, Clare College, have been appointed delegates at the coming conference of the universities of Great Britain and Ireland

Sir R H Biffen, St Catharine's College, Mr. R. Adie, Trinity College, Mr F L Engledow and Mr C W B Wright, St John's College, have been appointed to represent the scientific workers on the Station Committee of the Horticultural Research Station, while Messrs W. P Seabrook, A G Daniels, and A T Paskett represent the fruit and vegetable growers.

Notice has been given that an election will be made next July to the Charles Abercrombie Smith Studentship of 150*l* a year at Peterhouse. Every candidate must be or must become a research student, proceeding to the degree of Ph D The studentship is normally for two years and may be renewed in exceptional circumstances for a third year

DURHAM —The seventh Earl Grey memorial lecture will be delivered at Armstrong College on Thursday, March 5, at 7 30, by Dr F W Aston, on "The Structural Units of the Material Universe"

Applications are invited for the professorship in botany at Armstrong College The latest date for the receipt of applications (in each case ten copies) is May 15 They should be sent to the Registrar of the College, Newcastle-upon-Tyne

LONDON —The two following courses of free public lectures at the Royal School of Mines are announced "Chemical Combination in Metallic Alloys and its Nature," by Prof C. A Edwards, at 5 30, on March 3, 4, 10, and 11, and "Tubbing Deep Shafts" and "Subsidence," by Prof L Denoel, at 5 15, on March 16, 17, 18, and 19 Free public lectures will be delivered at University College as follows. on March 4, 11, and 18, "Nutrition of the Young Animal," by Prof T B Wood, and on March 9 and 11, "Vital Statistics," by Prof H Westergaard The lecture hour in each case will be 5 30

MANCHESTER —Messrs. Brunner, Mond and Co, Ltd, have continued their grants in aid of research in the Departments of Physics and Chemistry

The Council has adopted regulations for the award of the Philip Buckle Research Scholarship in agricultural zoology. This scholarship has been endowed in memory of the late Philip Buckle by his brothers and sisters

Mr J C Oakden has been appointed assistant lecturer in mechanical engineering in the Faculty of Technology

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THE City of Cardiff Education Committee will shortly appoint a head of the department of physics of the Cardiff Technical College Applicants for the post should send 20 copies of their applications and testimonials on or before Saturday, February 28, to the Principal of the College.

APPLICATIONS are invited by the Manchester Municipal College of Technology for the position in the college of lecturer in the chemistry of fermentation processes Particulars of the appointment and a form of application may be obtained from the Registrar The latest date for the return of the completed form is March 14

THE Commonwealth Fund, 1 East 57th Street, New York, was founded in 1918 by Mrs Stephen V Harkness "to do something for the welfare of mankind" and is a philanthropic institution which has already made some noteworthy gifts It is now announced that twenty fellowships a year in American universities, each of the value of about 600*l*, have been established for British graduates by the Fund The fellowships will be tenable for two years, and election will be by a committee of award consisting of Sir Walter Robert Buchanan-Riddell, Bt, Principal of Hertford College, Oxford (chairman), Sir Hugh Kerr Anderson, Master of Gonville and Caius College, Cambridge; Sir James Colquhoun Irvine, Principal of the University of St Andrews, Sir Theodore Morison, Vice-Chancellor of the University of Durham, and Prof T. Percy Nunn, Principal of the London Day Training College The Prince of Wales has consented to become honorary chairman of the committee The general object of the fellowships is to promote international goodwill and generally to foster unity of thought and purpose in the United States and Great Britain The awards will therefore be made on the basis of character, ability for leadership, health and general fitness, and on the nomination of recognised universities of Great Britain and Ireland.

MR H SIMPSON GEE, of Knighton Frith, Leicester, who died last July, bequeathed to University College, Leicester, of which he was honorary treasurer, 20,000*l* free of all duties, to found "The Simpson Gee Endowment Fund" Under the provisions of the will the executors could have deferred payment of the legacy for three years, but they generously offered to discharge the legacy forthwith and give the College the option of taking over certain specified securities of a full trustee character at the "market price" of the day This offer the College Council gratefully accepted, and as a consequence trustee stocks of this value have been transferred, by which the endowment income of the College has been augmented by 980*l* per annum Other gifts recently received are —2000*l* from Sir Jonathan North, chairman of the College Council (by which his donation to the General Endowment Fund has been brought up to 5000*l*), and 3000*l* from Messrs Stead and Simpson, Ltd, to the fund for endowing lectureships in chemistry and physics Leicester University College, although brought into existence in 1921 during the post-War economic depression, has, nevertheless, in addition to the finest site in Leicester, on the top of the city, and large and beautiful buildings and college gardens, valued at 150,000*l*, obtained an invested endowment fund which has just completed its first 100,000*l* In addition, it receives an annual grant from the city of Leicester. By the beginning of next academic year, it will have teachers in all the main subjects of university study, unusually adequate equipment in laboratories, and a library of 9000 volumes

THE annual distribution of prizes was held at the Sir John Cass Technical Institute, Aldgate, London, E C 3, on Tuesday, February 10, when the prizes and certificates were distributed by Mr. S O Nevile, past-president of the Institute of Brewing The chairman of the governing body, the Rev J F Marr, in giving a summary of the work of the Institute, stated that although the courses of study at the Institute are principally conducted in the evenings, no fewer than 36 students were successful at the examinations of the University of London during the past session, two of whom obtained the degree of Ph D, and three the degree of M Sc, by research. In addressing the students, Mr Nevile stated that institutes such as the Sir John Cass Technical Institute supply two urgent needs of modern industrialism they offer opportunities for advanced scientific education and training in research, and they enable those engaged in the minor ranks of industry to obtain a knowledge of the principles which underlie their daily work and a broader conception of their industry as a whole. The technology of brewing comprises—first, the production of the raw materials, secondly, the treatment of those raw materials to provide a satisfactory extract, and thirdly, the process of fermentation itself Pasteur must be regarded as the father of the modern conception of fermentation as applied to the brewing and wine industries Our knowledge of hops and barley is still very incomplete, and the research scheme of the Institute of Brewing is largely concentrated on these two main fundamental issues.

Early Science at Oxford.

February 22, 1683–4—A letter from Mr Aston dated Feb 14 was read, which gave an account of an experiment lately shewn before ye Royal Society by Mr Paget, viz ye south pole of ye inclinatory needle followed ye flame of a quarter of a sheet of paper, 5 degrees, ye side of ye box being very little hot, ye inclinatory needle was hung in ye plane of ye meridian, ye North pole shunned ye flame—With regard to a fountain in Poland, that is said to follow ye motion of ye Moon, is cold to ye touch, and yet easily inflammable, Dr Plot informs us, that there is a spring in Lancashire, which, though cold, takes fire, and will harden eggs

Concerning ye Lough-neagh stone, it was ordered, that ye Gentlemen of ye Society of Dublin should be desired, that they would be pleased to impart their thoughts concerning it, ye manner of its being made such, and of what materials it may be made

1686–7.—Mr Halley sent accounts (1) of Mr Hooke's hypothesis concerning ye changes which seem to have happened in ye surface of ye Earth, from ye shells in beds found petrified in ye Alps, and other hills far from, and above ye sea, and again sea sand and shells, found at great depths underground (2) Of an experiment of flint and steel in vacuo, which was that there were no sparks visible from ye collision, though they were very vivid in ye same receiver when ye air was admitted (3) Of a very strange effect of lightning from France, viz that something in it pierced through a piece of glass, making some holes about ye bignesse of pistol bullets, and melting ye edges of ye glass making it smooth like ye edges of a cup (4) That ye French in Canada have found a whole mountain of lead ore, which lies bare, so that there is no need of mining

Whereas Mr Hooke thinks that there are not extant any authentic records of ye latitudes of places sufficiently to evince ye fixation of ye Poles, Dr Bernard observes that ye latitude of Marseilles, taken by Pythias, in ye time of Alexander ye Great, appears to be ye same as 'tis now, and that in ye latter end of Julius Ffirmicus, is an observation of ye latitude of Oxford, taken about a hundred years since

Mr Lhwyd communicated ye following curiosities, sent out of ye Isle of Anglesey together with a collection of sea plants and shells—Eggs of Skate and Dog-fish, *Favus marinus Sibbaldi*, and a broad leaved *Fucus* which had a facing of fine silk in appearance, and was all over garnished with small filaments standing upright, about an eighth of an inch long, much resembling ye stamina of flowers This surface was easily scraped off, and was supposed to adhere to this plant after ye same nature that mosses, lichens, fungi, and such other vegetables adhere to stones, trees, bones, horns, etc

February 23, 1685–6.—A discourse concerning sounds and echoes, drawn up by Mr Walker, was by him communicated and read—Dr Plot communicated some shells, *Buccina*, in which ye spirals turn to ye left

February 24, 1684–5—A Horn was communicated by Dr Plot, said to be a horn, which grew behind ye head of a woman, who was shewn in London about fourteen years since, and is reported to have shed her horn once in three years This was sent by Mr Ashmole to be laid up in his Repository

A letter from Dr Howman, dated Norwich Jan 27, gave an account of a hydrophobia in an alderman of Norwich, caused by ye bite of a mad fox Mr Walker affirmed, that about fifteen years since a person died mad in Cheshire, having been bitten by a mad cat, which received its madness from ye bite of a mad dog

Societies and Academies.

London

Royal Society, February 12—H Muir **Evans** A contribution to the anatomy and physiology of the air-bladder and Weberian ossicles in Cyprinidæ In Cyprinidæ the air-bladder is constricted, so as to form an anterior and posterior chamber connected by a short duct The Weberian mechanism is designed to conduct vibrations and not to register variations of pressure The nerve-ganglion regulates tension of anterior sac and thus allows it to receive vibrations it controls the sphincters and prevents undue lowering of tension when the pneumatic duct is open, and excess of tension due to pressure of gas in the posterior sac—J S **Huxley** Studies on amphibian metamorphosis II It is not always possible to induce metamorphosis of the axolotl by enforced air-breathing in a considerable number of specimens This may be due to genetic differences between strains When axolotls are so treated the dorsal fin falls over and fuses completely with the skin of the back By using urethane it was found possible to keep frog tadpoles in narcosis for 8-12 days If previously treated with thyroid, they metamorphosed as rapidly as controls An atmosphere of oxygen is deleterious to tadpoles, and retards metamorphosis A mixture of air and oxygen containing 40 per cent oxygen allows metamorphosis to proceed at the same rate as in air The dorsal fin of male newts which is developed in the breeding season is not caused to regress by administration of thyroid, unlike the larval fin-crest occupying the same position—A S **Parkes** and J C **Drummond** Effects of vitamin-B deficiency on reproduction In a buck rat on a diet totally deficient in vitamin-B degeneration of testes and sterility ensue The amount of degeneration can be generally correlated both with degree of deficiency and time on the diet The fecundating power of the buck can be definitely correlated with degree of deficiency Size of litter, however, shows little variation The proportion of males among the young decreases.—A **Dendy** On an orthogenetic series of growth forms in certain tetraxonid sponge-spicules The so-called streptasters or siliceous spicules of the Theneidæ and Pachastrellidæ are not asters, and the spirally twisted axis which they exhibit is not an elongated centrum They are really derivatives of the primitive triact, which have arisen in accordance with a remarkable law of growth These spicules, for which the name "dichotriacts" is proposed, appear to form an orthogenetic series of growth-forms, probably representing both a phylogenetic and an ontogenetic series As in true asters, the increase in the number of rays is accompanied by diminution in size—C E **Walker**. The meiotic phase in Triton (*Molge vulgaris*) As is the case in the ordinary somatic mitoses, the univalent filament splits in the telophase of the somatic division immediately preceding the 1st meiotic (heterotype) division These semivalent threads rejoin in the early prophase, the univalent filaments thus formed join longitudinally, and at the anaphase whole somatic chromosomes are distributed to the daughter cells The splitting of the univalent filament in the telophase of the last somatic division is not consummated until the 2nd meiotic division, when the chromosomes split into longitudinal halves. The 1st meiotic division is a unique phenomenon interpolated between two mitoses providing for the equal distribution of whole chromosomes—W E **Alkins** *Clausilia bidentata* (Strom) and *Cl cravenensis* (Taylor) a statistical inquiry into the relationship of two similar species *Clausilia bidentata* is widely spread in Britain and elsewhere, *Cl cravenensis*

occurs only in a restricted area in the north of England, and its specific status has generally been questioned The altitude, diameter, and diameter/altitude ratio in series of each species collected from limited loci in which both species live together in the same habitat, have been studied While both species, and especially *bidentata*, are highly variable, and though local races may be distinguished within *cravenensis*, the two forms are clearly separated by biometric criteria, and there is no evidence of intermediate forms

Royal Microscopical Society, December 17—F W Rogers **Brambell** The part played by the Golgi apparatus in secretion and its subsequent re-formation in the cells of the oviducal glands of the fowl The Golgi apparatus in the *cells of the alveolar glands* undergoes hypertrophy during periods of activity and reduction during periods of rest It is not extruded with the secretion The *ciliated epithelium* lining the entire oviduct is also secretory During secretion the nucleus moves down the cell towards the lumen and the Golgi apparatus fragments, and is extruded from the cell The nucleus then moves to the back of the cell and the Golgi apparatus reforms *de novo* The albumen of the egg of the bird is homologous with the envelope of mucus formed around the egg of the mammal in the Fallopian tube In this respect the egg of Ornithorhynchus and the marsupials is intermediate The changes in the oviduct of the fowl between the laying of two successive eggs are comparable to the changes in the non-pregnant uterus of the mammal during the œstrous cycle —R J **Ludford** Some modifications of the osmic acid methods in cytological technique By treating suitably fixed tissues, after osmication, for 14-21 days with water at 35°-40° C, a good general impregnation of the Golgi apparatus can be obtained Sections can then be stained to demonstrate the mitochondria and nuclear structures Before staining it is desirable to treat sections with 0 1 per cent potassium permanganate, followed by sulphurous acid, in order to bleach the cytoplasm

Geological Society, January 7—A K **Wells** The geology of the Rhobell Fawr district (Merionethshire) The area described covers some 30 square miles centred about the mountain-mass of Rhobell Fawr The succession ranges from low down in the Lingula flags to the Bala mudstones A feature of special interest is the development of an igneous cycle at a lower level than anywhere else in North Wales The centre of eruption of which Rhobell is the denuded basal wreck, was a subaërial volcano which became active during the pre-Arenig interval Basic intrusions are common at several horizons between the Dolgelly beds and the Upper Acid group, and are without exception sills The area provides good illustrations of the action of an intrusive magma in persistently flooding certain horizons and invading selected rocks while leaving others unaffected As a consequence of its position at the south-eastern "corner" of the Harlech dome, the strike changes almost through a right-angle in passing from south to north. Folding along north-and-south axes is dominant, but the folds have been buckled against the Rhobell mass, which acted as a resistant knot lying in advance of the hard core of the dome The area is much faulted, the most important dislocations being parallel to those recently described from the Bala district

PARIS

Academy of Sciences, January 12—A **Lacroix** The meteorite of Roda A detailed mineralogical and chemical analysis of this meteorite is given, which only differs from the terrestrial harzburgites by containing a higher proportion of iron —Charles **Richet**, Eudoxie **Bachrach**, and Henry **Cardot** The heredity of acquired characters proved by the displacement of the thermal optimum A normal strain of lactic bacillus has a maximum development at a temperature of 36° C A strain of this bacillus, grown for three years in the presence of potassium chloride, has the optimum temperature raised by 6° C to 42° C, and this change persists and is characteristic of this strain of bacillus —C. **Camichel**, L **Escande**, and M **Ricaud** Overflow weirs —Paul **Vuillemin**: A normal classification, auxiliary classification, and practical grouping of the fungi —Bertrand **Gambier**: The invariants of Gauss, Beltrami, and Minding —A **Kolmogoroff**. The axiomatic definition of the integral —M **Lavrentieff** The sub-classes of the classification of M Baire —V **Weniaminoff** The limit-derivative of an analytical function.—Maurice **Roy** The adherence of a perfect liquid to a solid which it wets and Lagrange's theorem —Georges **Patart** The influence of the cooling of a gaseous fluid previous to its compression A demonstration of the advantages of a preliminary cooling of gases before compression —Emile **Belot** The movement of a vortex in a resisting medium application to planetary vortices —Rafael de **Buen** The influence of the surface temperature on deep thermal changes in the western Mediterranean A discussion of the experimental data given by Richard, Oxner, and Sirvent —H **Eyraud** The projective Riemann character of the electromagnetic gravific field —A. **Perot** A photographic recorder and oscillograph —Léon and Eugene **Bloch** The spark spectrum of tungsten in the Schumann region A catalogue of wave-lengths and intensities of tungsten lines between $\lambda=1826$ and $\lambda=1453$ —Charles **Chéneveau**. The formation of optically disturbed media by the penetration of a transparent liquid into a transparent resin. —Jean **Thibaud**. Research on characteristic gamma spectra by crystalline diffraction The method employed was that of the rotating crystal (velocity less than 1° in 24 hours) and Broglie photographic recorder. The γ spectra were obtained as fine lines without signs of any continuous bands The crystal diffraction method furnishes a good confirmation of the values attributed to the γ frequencies by the method of excited β spectra —Fred **Vlès** and Mlle. Madeleine **Gex** The ultra-violet absorption of petrols A study of the changes produced in the absorption bands by fractional distillation —H **Pélabon** The direct formation of the mercury oxychlorides. The three oxychlorides, $HgO\ 2HgCl_2$, $2HgO\ HgCl_2$, $4HgO.HgCl_2$, can be formed directly from HgO and $HgCl_2$ in the presence of water and of alcohol if the temperature is low. The first of these is white and is not formed if the temperature rises above 30° C, but once formed, can be heated to 100° C without decomposition —Emile **Luce** Researches on the migratory aptitudes of the α-naphthyl radicle —— **Royer** · The rotatory power of cholesterol bodies —E **Fournier** A mode of capture by subterranean erosion, special to certain closed basins of the chain of the Jura —Ch **Gorceix**: The metric proof of the ovoid form of the earth. The ovoid proposed as the best representation of all the available geodesic measurements is intermediate between the ellipsoids of Clarke (1880) and Bessel (1841) —Jean **Piveteau** The existence of a reptile with lacertilian affinities in the permian formations of Madagascar The name *Broomia Madagascariensis* is given to this reptile, which is represented by a large number of well-preserved examples, only the head presenting difficulties —G **Mangenot** The

mode of formation of starch grains in the latex of the Euphorbiaceæ.—Maurice **Lenoir**: The telophase of the first division in the embryonic sac of *Fritillaria imperialis*.—Vittorio **Pettinori**: The toxic action of *Amanita phalloides*. This poison acts not only on vertebrates, but also on infusoria, small crustaceans, the larvæ of insects and fishes. It has no action on the isolated heart of the frog, and probably is without action on lizards and frogs.—Gilbert **Ranson**: The cause of the green coloration appearing on oysters. The pigment of *Navicula ostrearia*, which is unaffected by the digestive juices of the oyster, is shown to be the cause of the green coloration.—Harry **Plotz**: Some observations on the mechanism of serum anaphylaxy. In anaphylaxy produced by serum injection two factors intervene: the physico-chemical state of the serum used for the sensitising injection, and the physico-chemical state of the second injection.—Georges **Bourguignon** and Mlle Renée **Déjean**: Double chronaxy of the optical system in man.—Jean **Camus** and J. J. **Gournay**: Researches on diabetes and diuresis.

MELBOURNE

Royal Society of Victoria, November 20.—J. **Ewart**: Stock poisoning in the Northern Territory. Along the main stock route in the Northern Territory very heavy losses of stock have been experienced in recent years and their cause has been in doubt. The cause was determined, by actual experiments carried out in Central Australia on a herd of cattle, to be poisoning due to *Indigofera boviperda*, the indigo cattle bane, and to *Isotropis atropurpurea*, the poison sage. The former is well known as a cattle-killer in Western Australia, but was not previously recorded as killing stock in the Northern Territory. It loses its poisonous properties when dried in a hot sun, owing to the ready decomposition of its alkaloid "cygnin." The Isotropis was not previously recorded as a poisonous plant. It is less poisonous than *Indigofera boviperda*, but the poison is more stable. An extract obtained by Dr. Young is poisonous to guinea-pigs, but the nature of the poison is as yet unknown.—C. **Fenner**: The Bacchus Marsh basin, Victoria. At a period somewhat earlier than middle Tertiary, the whole of Eastern Australia, including Victoria, consisted of low undulating highlands and vast level plains, well wooded and well watered. Under these conditions great brown coal deposits of Victoria, etc., were built up. Later there came some differential uplift of the land, and associated with this there was an outpouring of basaltic lava (the "older basalts"), and about this time the subsidence of Bass Strait possibly commenced. Later, there was another volcanic period (the "newer basalts"); these flows dammed up many of the streams, and filled up some of the old valleys, forming lakes and twin streams and causing a complete change in the drainage system. The faulting which followed or accompanied this volcanic period gave rise to the great mountain system of Eastern Australia. Locally it caused additional alteration in the stream activities. Thenceforward the natural downward cutting, side-swinging, and headward erosion of the Bacchus Marsh streams brought about the formation of the basin as it exists to-day.—A. H. **Coulsen**: Geology of the Coimadai area, Victoria, with special reference to the Limestone series. Lower Ordovician and Permo-Carboniferous glacial rocks form the basement of the area, but the paper is concerned with the Kainozoic rocks. These comprise gravels, sands, etc., monchiquite dykes and basalt. The limestone, or more properly dolomite, contains fossils and a very finely laminated mudstone with small grains which bear a strong resemblance to the pollen grains of Pinus. The grains sometimes have a quadrate centre and at others there is a suggestion of spines and wings. The fossils are all referable to the Pleistocene. The extreme uniform fineness of grain and the absence, with one or two possible exceptions, of calcareous organisms, suggest that the dolomitic limestone is the result of deposition of a chemical precipitate of magnesian limestone and differential leaching, in places, giving a more magnesian limestone. Basaltic lava flows followed the sedimentation in the lake, but were preceded by the outburst of a fine ash which has only been found in the limestone lake. The outpouring of basalt completely altered the drainage system of the area. Pyrete and Goodman's Creeks came into existence and deposited, in their initial stages, high level gravels as a capping over the older rocks. In deepening their channels they carried away much of the softer gravels of the old "Bullengarook River," destroyed the limestone lake, and removed most of the limestone, the remnant of which is now covered by the higher gravels of these streams.

Official Publications Received.

Carnegie Institution of Washington. Year Book No. 23, November 1, 1923, to June 30, 1924, with Administrative Reports through December 12, 1924. Pp. xx+43+325. (Washington, D.C.)

Medical Schools of the World. Pp. 26. (New York: The Rockefeller Foundation.)

Commonwealth of Australia: Institute of Science and Industry. Bulletin No. 28: Problems of the Viticultural Industry. By A. V. Lyon. Pp. 84. (Melbourne: H. J. Green.)

University of Oregon Publication. Vol. 2, No. 7, November: A Proposed Classification of Igneous Rocks. By Edwin T. Hodge. Pp. 72. (Eugene: University of Oregon Press.) 1 dollar.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 47: Cotton Growing in Relation to Climate in Egypt and the Sudan. By C. B. Williams. Pp. ii+81+9 plates. (Cairo: Government Publications Office.) 5 P.T.

The South African Journal of Science. Vol. 21, November. Comprising the Report of the South African Association for the Advancement of Science, 1924, Cape Town. Pp. xl+698+xx. (Johannesburg.) 30s. net.

Hampstead Scientific Society. Report of the Council and Proceedings, with a List of the Members, for the period October 1922 to September 1924. Pp. 70. (London: 32 Willoughby Road, N.W.3.)

Nyasaland Protectorate: Department of Agriculture. Bulletin No. 1 of 1924: The Destruction of Vegetation and its Relation to Climate, Water Supply and Soil Fertility. Part 1: General Effects of the Destruction of Vegetation, by Dr. F. Dixey; Part 2: The Relation of Forest Vegetation to Climate, Water Supply and Soil Erosion, by J. B. Clements; Part 3: The Erosion of Arable Soil in Nyasaland and Methods of Prevention, by A. J. W. Hornby. Pp. 16. (Zomba.)

Smithsonian Institution: The Smithsonian Institution's Study of Natural Resources. Niagara Falls: its Power Possibilities and Preservation. By Samuel S. Wyer. (Publication 2820.) Pp. vi+28+2 plates. (Washington, D.C.)

Carnegie Institution of Washington. Annual Report of the Director of the Laboratory for Plant Physiology. (Extracted from Year-Book No. 23, for the Year 1924.) Pp. 125-143. (Washington, D.C.)

New South Wales: Department of Mines: Geological Survey. Bulletin No. 7: Gold. By E. J. Kenny. Pp. 60+10 plates. 2s. Bulletin No. 8: Aluminium (Alunite and Bauxite). By L. F. Harper. Pp. 21. 1s. Bulletin No. 11: Cadmium and Mercury, or "Quicksilver." By E. J. Kenny. Pp. 12. 1s. (Sydney: Alfred James Kent.)

Diary of Societies.

SATURDAY, FEBRUARY 21.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3.—Miss Isabel Burnett: Motives in the Acquisition of Skill.—Prof. T. H. Pear: On Forgetting the Unpleasant: An Examination into Recent Criticisms of Psycho-analysis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Rothenstein: The Artist's Relation to Social and Religious Life (II.).

PHYSIOLOGICAL SOCIETY (at London School of Medicine for Women), at 4.—G. Briscoe: Pressure of Phrenic Effects on Conduction of Respiratory Impulses.—E. E. Hewer and M. F. Lucas-Keene: Histological Preparations of certain Fœtal Tissues (Human).—J. W. Pickering: The Supposed Deficiency of Pro-Thrombin in Hæmophilic Blood.—W. Cramer: The Process of Secretion in the Thyroid Gland.—J. F. Fulton: Plurisegmental Innervation of Single Muscle Fibres (Frog).—A. St. G. Huggett and Prof. J. Mellanby: Preparation and Properties of Secretin.—R. E. Havard and G. A. Ray: The Effect of Exercise on Blood Phosphate.—J. B. S. Haldane: Some Effects of ingesting $MgCl_2$ and $SrCl_2$.—A. D. Ritchie: Chloroform Rigor in Frog's Muscle.—J. H. Burn and H. P. Marks: The Relation of the Thyroid Gland to the Action of Insulin.—F. C. Kelly: The Effect of Iodine on the Metabolism

of Nitrogen and Phosphorus in the Growing Pig —A D Kay and W Smith The Effect of Insulin on Blood Volume —H Florey Microscopical Observations on the Cerebral Circulation —D Woodman Effects of Parathyroid Feeding —E C. Pillman-Williams Blood Nitrogen Values during Labour

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District) (at Municipal Buildings, Blyth), at 5 —L Leeper Five Years' Progress at Blyth —J L Turner The Law relating to the Collection of House Refuse and Trade Refuse.

MONDAY, FEBRUARY 23

ROYAL IRISH ACADEMY, at 4 15

ROYAL SOCIETY OF EDINBURGH, at 4 30 —Dr B N Peach and Dr. J Horne The Scientific Career of Sir Archibald Geikie

VICTORIA INSTITUTE (at Central Buildings, S W), at 4 30 —Prof A T Clay The Amaru

INSTITUTE OF ACTUARIES, at 5 — F L Collins Winding up a Life Assurance Company under the Provisions of Section 17 of the Assurance Companies Act, 1909

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Dr G W De P Nicholson The Nature of Tumour Formation (I)

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —W E Warrilow and others Discussion on the Electrical Journals, Past, Present, and Future

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle on-Tyne), at 7 15 —H W Clothier The Design of Electrical Plant, Control Gear, and Connexions for Protection against Shock, Fire, and Faults

ROYAL SOCIETY OF ARTS, at 8 —Dr W Rosenhain . The Inner Structure of Alloys (II) (Cantor Lectures)

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8 — F N Doubleday . Report upon Some Drugs and Solutions used in Local Anæsthesia

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Sir Gerald Lenox-Conyngham The Great Barrier Reef

MEDICAL SOCIETY OF LONDON, at 8 30 —Sir G Lenthal Cheatle The Early Stages of Pathological Hyperplasia in the Breast, with special reference to Cysts and their Danger

TUESDAY, FEBRUARY 24

ROYAL DUBLIN SOCIETY (at Royal College of Surgeons, Dublin), at 4.15 — Prof F E Hackett and others Discussion on Modern Theories of Atomic Structure

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4 30 — R H Brackenbury Transport in Tropical Africa

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof J Barcroft The Colour of the Animal Creation (III) The Colour of the Chameleon

ROYAL SOCIETY OF MEDICINE, at 5 30 —General Meeting

INSTITUTION OF CIVIL ENGINEERS, at 6 —L H Savile The Demolition of the Harbour and Defence Works of Heligoland.

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at 83 Pall Mall), at 7.—Discussion on Curious Breakdowns

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7 — T D Trees Selection of Ball and Roller Bearings for Electrical Machines

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —K C D Hickman Colour and the Psychology of the Kinema —O Bloch A Daylight Viewing and Projecting Filter for Autochrome Plates —Miss Catharine O Stevens A Plea for the Kinematography of Wind Waves

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7 15 —R N Aveline The Testing of the Automobile

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30 —H H Blache The Latest Type of the Burmeister and Wain Diesel Engine

ROYAL ANTHROPOLOGICAL INSTITUTE (at London School of Economics), at 8.15 —L H Dudley Buxton The Stoney Indians of the Bow River, Alberta

WEDNESDAY, FEBRUARY 25

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Dr G W De P Nicholson The Nature of Tumour Formation (II)

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —Prof A H Cox · (a) The Geology of Cader Idris (Merionethshire) , (b) The Dissection of Pitching Folds

NORTH - EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Mining Institute, Newcastle-on-Tyne), at 7 15 — Prof T H Havelock The Principle of Interference in Ship-waves and Ship Resistance

INSTITUTION OF ENGINEERS-IN-CHARGE (at St Bride Institute, Bride Lane, E C), at 7 30 —Discussion on Responsibilities and Difficulties of the Engineer-in-Charge

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7 30 —Dr J A Murray The Making of Microscopical Preparations (I) Wet Preparations —F Summers Applications of the Microscope in Textile Research —T B Bright Methods of Examination of Mildewed Cotton Material

ROYAL SOCIETY OF ARTS, at 8 — Sir Dugald Clerk The Power of Internal Combustion Engines for Motor Cars

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8 30 —Dr N H M Burke Some Aspects of the Inter-relation between Bodily and Mental Disease

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Liverpool)

THURSDAY, FEBRUARY 26

ROYAL SOCIETY, at 4 30 —Prof E H Starling and Dr E B Verney The Secretion of Urine, as studied on the Isolated Kidney —F Eichholst and Prof E H Starling The Action of Inorganic Salts on the Secretion of the Isolated Kidney —Dr G V Anrep A New Method of Crossed Circulation —Dr G V Anrep and I de B Daly The Output of Adrenaline in Cerebral Anæmia, as studied by means of Crossed Circulation —Dr G V Anrep and Prof E H Starling Central and Reflex Regulation of the Circulation — K Furusawa Muscular Exercise, Lactic Acid and the Supply and Utilisation of Oxygen Part IX Muscular Activity and Carbohydrate Metabolism in the Normal Individual —*To be read in title only* —A Hunter and J. A Dauphinee (a) Quantitative Studies concerning the Distribution of Arginase in Fishes and other Animals , (b) An Approximative Colorimetric Method for the Determination of Urea with an Application to the Detection and Quantitative Estimation of Arginase —Dr J J R Macleod and N A. McCormick The Effect on the Blood Sugar of Fish of various Conditions, including Removal of the Principal Islets (Isletectomy)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 — Sir Arthur Smith Woodward Dinosaurs (I)

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7 30 —W B Draper The Balancing of Automobile Engine Crank Shafts

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8 —Sir William B Hardy Problems presented by Films on Solid Surfaces

INSTITUTION OF STRUCTURAL ENGINEERS (at 296 Vauxhall Bridge Road), at 8 —E Godfrey Reinforced Concrete Columns

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Section).

FRIDAY, FEBRUARY 27

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5 —J J Manley Notes concerning the Sprengel Pump —J Young The Thomson Effect in Copper, Iron, and Carbon Steels —D W Dye Improved Cathode Ray Tube Method for the Harmonic Comparison of Frequencies and for the Delineation of their Wave Form

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Dr G W De P. Nicholson The Nature of Tumour Formation (III)

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7 —J Mitchell Research in Industry

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Discussion on Practical Problems of Lubrication

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —H Pickwell The Monuments and Fountains of London

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House, Adelphi), at 7 30 —R Marks Why Pneumatic Tires?

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —E Stroud A Treatise on Modern Lighting Practice

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-on-Tyne), at 7 30 — Prof A L Mellanby and Dr W Kerr Limiting Possibilities of Steam Plant

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (in Cleveland Scientific and Technical Institution), at 7 30 —G M Harroway The Problem of the Workshop

EUGENICS EDUCATION SOCIETY (at Royal Society), at 8 30 —Dr B Malinowski Mate Selection in Primitive Society

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir James C Irvine Sugars from the Standpoint of the Organic Chemist.

SATURDAY, FEBRUARY 28

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford The Counting of the Atoms (I)

PUBLIC LECTURES.

SATURDAY, FEBRUARY 21

HORNIMAN MUSEUM (Forest Hill), at 3 30 — F Balfour Browne My Journey to Brazil

MONDAY, FEBRUARY 23

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —Dr E B Behrens International Problems of Industry Problems of the Future

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (Royal School of Mines), at 5 15 —Prof L Denoel Tubbing Deep Shafts and Subsidence (Succeeding Lectures on February 24, 25, 26)

BIRKBECK COLLEGE, at 5 30 —Dr G G Coulton Medieval Education (IV) The Medieval University

KING'S COLLEGE, at 5 30 —Prof W T Gordon The Geological History of Plants (Swiney Lectures) (Succeeding Lectures on February 25, March 2, 4, 9, 11, 16, 18, 23, 25, 30, April 1)

TUESDAY, FEBRUARY 24

KING'S COLLEGE, at 5 30 —Prof W J De Burgh Neo-Platonism and Christianity

GRESHAM COLLEGE, at 6 —Prof W H Wagstaff Geometry (Gresham Lectures) (Succeeding Lectures on February 25, 26, 27)

LEEDS UNIVERSITY, at 8.—Prof W Garstang Animal Life on the Yorkshire Coast

WEDNESDAY, FEBRUARY 25

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5 —C H C Baker The Principles of Design as applied to our Homes

ROYAL SOCIETY OF MEDICINE, at 5 —Prof R Cruchet The Relation of Paralysis Agitans to the Parkinsonian Syndrome of Epidemic Encephalitis

KING'S COLLEGE, at 5 30 —Dr. Eileen E Power Travel and Travellers of the Middle Ages (VII) The Opening of the Land Routes to Cathay, A D 1200–1350

THURSDAY, FEBRUARY 26

UNIVERSITY COLLEGE, at 5 —G A Sutherland Auditorium Acoustics (Succeeding Lectures on March 5, 12)—At 5 15 —Sir Henry Hadow The Place of Music in University Education.

KING'S COLLEGE, at 5 30 —Prof E W Scripture German Poets and their Verse

SATURDAY, FEBRUARY 28

HORNIMAN MUSEUM (Forest Hill), at 3 30 —W J Perry The Ancient Mariners of the Pacific

SATURDAY, FEBRUARY 28, 1925.

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Editorial and Publishing Offices,
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Words, Meanings, and Styles.

II.

THE first element of good style is clearness, and this may or may not be combined with literary elegance It is usual to regard a split infinitive as a sign of indifference to pure English, yet this misplacement will be found in the works of some of our leading writers. The practice is discussed in an open-minded manner in Tract No. XV recently published by the Clarendon Press for the Society for Pure English; and though no precise conclusions are reached whether it is permissible or no, the general view taken is that when a split infinitive is the best form of avoiding ambiguity it can be justified It is admitted that the separation of *to* from its infinitive is not in itself desirable, but, on the other hand, obvious artificiality may be introduced when the practice is regarded as a fetish "To see clearly" is certainly preferable to the split infinitive "To clearly see"; and "To be clearly seen" or "To be seen clearly" to the form "To clearly be seen," but it is difficult sometimes, without splitting the infinitive, to retain the meaning desired Thus, the pamphlet referred to gives as an example the phrase "we must expect the Commission to at least neglect our interests" To place the words "at least" anywhere else in the sentence would not convey exactly the same idea, and instead of changing their position it would be better to recast the sentence. People who deliberately avoid split infinitives have often an objection to divide a compound verb by adverbs, so that they would write "earnestly may be hoped" instead of "may be earnestly hoped." There is, however, no grammatical reason against such splitting as there is in splitting an infinitive, indeed, the proper place for the adverb is between the auxiliary and the principal verb

From the point of view of correct grammar, the conjunction "and" ought not to be used to begin a sentence, in spite of its common use in this place in the Authorised Version of the Bible The function of the word is to add one word or clause to another in a sentence, and this rule is broken when the word opens a new sentence The incorrect use of "and which" is very common Generally, either the pronoun or the conjunction should be omitted, or the former is misplaced When entirely different statements are expressed by two clauses of a sentence, or the cases are different, the relative may be repeated, but not otherwise. Thus it is correct to write, "The results, which support my earlier views, and which I will describe," or "His work on behalf of the scientific world, which he has served so well, and which esteems him so highly," but not "These phrases, which are irritating to read, and which are met every day," or "It is a principle

which is easily understood and which is also easily forgotten." The best way to avoid flagrant errors in regard to the use of "and which," "but which," "and who," and similar combinations, is to omit whatsoever word is intrusive or redundant. That is, indeed, the touchstone by which most questions of literary style may be tested.

As to particular words and phrases, some of these in common use are indefensible, while the use of others must be left to personal taste to decide. It is fatuous to write "to the foot of the letter" instead of "literally," and clumsy to use "it goes without saying" for "it need scarcely be said" or "needless to say." "In the circumstances" is obviously a more correct phrase than "under the circumstances," and "to direct attention" is preferable to the usual form "to call (or draw) attention." "Last," which denotes position, should not be used in the sense of "latest," which signifies time. To use the word "phenomenal" to describe remarkable things or events having nothing to do with phenomena is to adopt inept journalese of the same type as the use of the verb "to transpire" in the sense of "to happen." For the use of "over" in the sense of "more than" there is no justification, and "scarcely" is always the correct word to use instead of "hardly" in expressing quantity. "To try an experiment" for "to make an experiment" is, of course, wrong. "After" or "later" is usually preferable to "subsequently", "total" or "whole" to "aggregate", "viewpoint" or "point of view" to "standpoint", "first" to "firstly"; "person" to "individual" except where a single or separate person is specified, "common" to "mutual", "largely" to "materially", and there are many other preferences of a like kind.

Purists object strongly to the word "reliable" because of its irregular formation, though the same objection can be made to the words "laughable" and "indispensable." Some authors make the distinction of applying the word "reliable" to things or statements, and "trustworthy" to persons, and that is the general practice followed in these pages. It would be pure pedantry to refer to an engine as "trustworthy" instead of "reliable," and stupidity to describe "reliability tests" as "trustworthiness tests." Mr. B. J. Hayes, writing from Burlington House, Cambridge, objects to the use of the word "humanoid" in NATURE of February 7 (p. 201, bottom of column 1), and suggests that "hyperanthropoid" would make the use of the hybrid word unnecessary. His word, however, though correctly formed, would signify that the type referred to as humanoid was in the same direct line of development as anthropoid, whereas it belongs to a separate line.

Most of these distinctions are, however, relatively minor matters from an editorial point of view compared with diversities of paragraphing, punctuation, use of capitals, inaccuracy of quotation, and incorrect references, which come under consideration every day. It is, of course, undesirable to insist upon a uniform style of paragraphing or punctuation, and all that we would urge is that long paragraphs and long periods put too much strain on the powers of attention of the reader. There is little possibility, in scientific articles, of offending in the other direction by over-shortening paragraphs and periods until they reach the staccato style of the sprightly part of the daily press.

A quotation may be used as an apt illustration of a particular point, or as a statement of the nature of evidence on one side or the other bearing upon the case upon which judgment is being expressed. Of the former class, the authors of "The King's English" describe as trite: balm in Gilead, *e pur si muove*, a consummation devoutly to be wished, the irony of fate, the psychological moment, the pity of it, and many others; and they give the following among common misquotations, the corrections being in brackets: A *poor* thing, but mine own (an ill-favoured), *small* by degrees and beautifully less (fine), *the* last infirmity of noble *minds* (that, mind); make assurance *doubly* sure (double), a goodly apple rotten at the *core* (heart).

We are, however, more concerned with material than with formal quotations, and our experience is that very many writers fail to realise the necessity of reproducing with literal accuracy the extracts they quote, whether for approval or criticism. The number of variations which writers make, deliberately or inadvertently, from the original text is really astonishing to any one who goes to the trouble of verifying what is quoted. It cannot be too strongly insisted upon in a scientific journal that not merely the sense but the actual words and form should be reproduced exactly in a quotation, and that punctilious care should be taken in this respect when the quotation is from a book under review, or from a contribution upon which comments are being made. No wiser advice could be given than that of "verify your references," whether these signify volumes, dates, and pages, or actual quotations.

While an editor can scarcely be held responsible for the accuracy of all the quotations made by his contributors, it is his duty to secure reasonable uniformity in various elements of grammatical and typographical style. For example, certain collective nouns, such as Ministry, Government, Council, Board, Commission, Committee, are used by some writers with a singular verb and by others with a plural. In official practice the plural is commonly used, as "The

Ministry have decided", here the noun signifies the members of the Ministry and its sense is, therefore, plural. When, however, plurality is not intended, and reference is to a single body, it would seem to be equally correct to use a singular verb. We prefer the verb and the pronoun to be singular, as with a "nation" or "people," where they are always used rightly. On the other hand, nouns like the United States, Physics, and Mathematics, though plural in form are singular in meaning and a singular verb is, therefore, used with them Here it is not a matter of preference or consistency but of accurate diction

This brings us to the use of capitals, and there does not seem to be any general rule for capitalisation other than that of the initial letter of the word beginning a sentence Some authors tend towards the German style of writing every noun with an initial capital, but few follow a definite plan, and it is left to editors or printers to secure reasonable uniformity in this respect. Our custom is to use capitals in Latin scientific names of orders, genera, and so on, but not in corresponding English words Thus, we should print Coniferæ, but without the capital letter in conifers, and similarly, Amphibia or amphibians, Crinoidea or crinoids Every week, however, brings difficulties in the application of any general rule to contributions of different authors, and we have to exercise the editorial prerogative in deciding whether initial capitals should be used or no in such words and terms as Radium-D, Department, Faculty, State, Parliament, Superintendent, Director, Report, Tertiary age and Stone Age, Neolithic Man, Miocene Period and Celtic period, London Clay (or clay), Ångstroms, Theory of Relativity, Quantum Theory, Correspondence Principle, names of elements and minerals, and a host of other examples of a similar kind

In general, our rule is to use initial capitals only when specific institutions, bodies, divisions, and so on, are referred to, and not when these are described in a generic sense. Thus, we should print, the University of Cambridge, but British universities; the British Scientific Instrument Research Association, but industrial research associations; the House of Commons, but the state legislature, the Middlesex Education Committee, but local education authorities, the State of New York, but the northern states, the Galaxy, but the stellar universe. It may be said, therefore, that initial capitals are used only when they are positively necessary for precise description, and are avoided unless there is an essential reason for them. We realise that our decisions are sometimes purely arbitrary, but in the absence of established principles they cannot be otherwise.

There is only one other matter to which we wish to refer in concluding this discursive article: it is that of the common belief that writers on scientific subjects compare unfavourably with workers in other intellectual fields in the capacity to express themselves in suitable words, or in their appreciation of good English We cannot accept this view for a moment, and we resent strongly the supercilious attitude which literary people often present towards scientific works. It seems to be taken for granted by some writers who survey published literature from week to week, that no work of science can possibly be classed as literature We do not hesitate to say, however, that, judged by literary standards alone, scientific books are published every week more worthy of comment than many of those selected to represent the week's literature Though classical scholars and men of letters may not think it derogatory to be without a knowledge of science, most men of science are familiar with one or two languages in addition to their own, and they have, at any rate, a certain acquaintance with the art of literary expression and often the desire to perfect themselves in it. The vocabulary of a man of science is probably more extensive than that of a man of letters of equal authority, but it includes many technical words which are understood only by workers in particular fields and cannot be used effectively, therefore, when addressing a wider circle

That is the chief distinction which need be made between scientific articles and books and those of a purely literary kind It is not necessary for a chemist who is writing for chemists to describe the scientific words and phrases he uses any more than it is for the literary man to explain his allusions, or the historian the significance of his periods and characters. When, however, a chemist is addressing the world of science as a whole, he must avoid the special language of his branch of science if he is to be intelligible, and if he is writing for the general public he has to do so in everyday words and phrases. The standard of suitability of contributions to *Chemistry and Industry* differs, therefore, from that of a general scientific periodical such as NATURE, and this differs again from that of a daily newspaper or of a parish magazine. It ought not, however, to be too much to expect in these days that educated men and women should be acquainted with words and phrases which are part of the common vocabulary of science; and if that desideratum be granted, we may safely claim that the writings of many men of science are truly literary in style as well as scientific in substance, while as regards originality of fact and idea, they are far in advance of all other published works

The Australian Opal.

Opal: the Gem of the Never Never By T. C. Wollaston Pp. xi+164+15 plates (London T Murby and Co., 1924) 10s 6d net.

OF precious gems the opal and the pearl take pride of place, for they seem to become part of their wearers, throwing up their beauty and receiving from them additional lustre. Our author has tried both, for he once ran a pearling fleet from Torres Straits to Timor-Laut, but sold out in favour of developing the opal, which seems to him "to be alive and almost as precious as a rose or daffodil" This expresses the motive of the book, the author a naturalist first—a true Wollaston—secondarily, the exploiter of the Australian gem, which he clearly regards as primarily connected with living organisms

The opal is usually described as an hydrated silica which has consolidated unequally, contracting in different directions It shows iridescent reflections from surfaces, irregular both in dimensions and arrangement, which by some authorities have been regarded as microscopic pores, arranged parallel (Crookes), while others suppose the inclusion of thin laminæ of foreign substances of different indices of refraction (Behrens), this meaning rich interference phenomena. The amount of water varies up to 13 per cent, and the product fluctuates from a colourless or black glassy substance to the most wonderful play of colours There has, however, been little recent research on the opal, and these statements as to its structure are based on Hungarian, Mexican, and Honduras stones, which are not necessarily the same in structure as the Australian

The position would seem to be that there was a sea which in Cretaceous times connected the Gulf of Carpentaria and the Great Australian Bight It extended over the western halves of Queensland and New South Wales and covered most parts of the Northern Territory and South Australia, ending to the west at an undefined line in Western Australia Then came the upheaval and the whole was covered with a desert sandstone This has mostly disappeared by denudation, but its remains are found in a line of low ranges and tablelands down the middle of Queensland and New South Wales, close to the eastern edge of the desert; there is also a big patch, Coberpedy, in the centre of South Australia These are the bare bones of facts, which the author amusingly clothes throughout his book with an unblushing and charming fantasy

Everywhere in this desert, sandstone is found showing a tendency to opalisation, but the precious opal occurs principally in its basal part in a thin band or "casing" over underlying clay. Concretionary boulders or nodules of siliceous ironstone are also found containing precious opal, but a usual occurrence in the sandstone is in pipes of about the length and thickness of a pencil, these frequently show colour repetitions along their lengths, more likely, we think, to be metameric repetitions in deposition than due to "unequal pressure" All sorts of cracks and crevices in the sandstone are filled up, and the best colours are frequently shown in small sheets, only 1 to 2 mm thick.

At the British Empire Exhibition at Wembley the author and others showed an immense variety of specimens Some were opalised wood, while opals in spaces naturally formed in the decay of wood were also shown Then there was a great variety of bivalve and coiled shells, some of which appeared to have the shell replaced by opal, but most, perhaps, were rather of the nature of casts. Some specimens, particularly of the blackest opal, on superficial inspection irresistibly suggested sponges and corals Yet in others, more transparent, transmitted light revealed dark mossy growths, bearing a peculiar resemblance to the boring growths of algæ and sponges in coral, as seen after decalcification Then there were numerous casts of the small bones and vertebræ of reptiles and of fish, in some cases surrounded by actual bone Most of the opal had no visible connexion with organic remains, but yet, as our author points out, nearly all Australian opal has a pattern of some sort in it, often in squares or parallel lines, the colour boundaries, too, are generally determinate Metameric repetition is very usual in the structure of animals, and we saw much in these opals that suggested such structure, but it is hard to suppose that the basal opalised band is directly connected with former organic life In any case, Mr Wollaston's account and specimens leave one with the impression that the combined effects of light and structure, from which the opal derives its beauty, are quite probably not the same in the Australian as in the older known opals and demand further investigation, for which the author offers to put material at the disposal of competent researchers.

For the rest, the book contains no systematic and dry-as-dust account of the opal country, there are an extraordinarily interesting series of word pictures, painted with great freshness and vigour We have rarely read a more vivid diary than that of a visit paid to the opal country in 1888, roughly 1000 miles from Adelaide along the eastern edge of the Great Desert, mostly camel-riding The journey had all the elements of adventure about it, dangers of direction and of drought, but above all it is a picture of the

"Never-never" land as seen by a real man. Nature is sketched in with a full brush, and the result on the reader's mind is a vivid picture of one of the least known parts of the world, made interesting by a wealth of scientific problems, physical, geological, and biological, crying out for investigation The many touches of fancy and personality, which make this book so suitable for popular reading, must not be allowed to obscure its value as a distinct contribution to knowledge J. STANLEY GARDINER

Endocrine Organs and Secretion.

(1) *The Endocrine Organs an Introduction to the Study of Internal Secretion.* By Sir E. Sharpey-Schafer. Second edition Part 1 The Thyroid, the Parathyroids, and the Suprarenal Capsules. Pp ix+175 (London · Longmans, Green and Co, 1924) 15*s* net

(2) *An Introduction to the Study of Secretion* By Prof Swale Vincent Pp 168 (London · E Arnold and Co, 1924) 10*s* 6*d* net.

(3) *The Parathyroid Glands in Relation to Disease* By Dr H. W. C Vines Pp viii+128 (London · E. Arnold and Co, 1924) 10*s* 6*d* net.

SIR EDWARD SHARPEY-SCHAFER'S well-known book on the endocrine organs, which was founded on a course of lectures (Lane Medical Lectures) delivered at Stanford University in California in 1913, is being rewritten in two volumes, of which the first only (1) has so far been published. This volume deals with the general considerations of internal secretions and the organs which furnish them, and then proceeds to a detailed treatment of the thyroids, parathyroids, and suprarenal capsules Part 2, which deals with the remaining endocrine organs, will appear later.

Part 1 of the new edition is rather larger than the whole of the first edition, and its greater bulk has been necessitated by a more complete description of the organs and their secretions, and by the addition of many excellent illustrations. The more important literature, and particularly recent literature, is given in footnotes on the pages on which it is referred to in the text. The references are numerous, and while they do not obtrude in any way upon the text, will be found very convenient to any one who wishes to consult the original papers The literature on endocrinology is enormous, and wide knowledge, personal experience, and a critical judgment are required of any one who attempts to disentangle salient facts from hypothesis No one is better qualified than the author to undertake such an analysis, for there are few problems in endocrinology of which he has not a first-hand knowledge The result is a full, authoritative, yet not dogmatic presentation of the subject, which, when completed by the issue of Part 2, will make these volumes the standard work on the endocrine organs.

(2) Prof Swale Vincent's book is an account of the process of secretion based upon a series of lectures given to medical students at the Middlesex Hospital during 1922–23 Much of it is of necessity elementary, but certain forms of secretion which do not appear in ordinary physiological literature are included, *e g* the secretion of gases by the gas bladders of teleostean fishes, hirudin by the leech, silk, the webs of spiders, poisons, the inky secretions of cephalopods, and the luminous substances of light-producing organisms. The anatomical and histological characteristics of the glands are fully described, and most of the illustrations in the book are of histological appearances

Much interesting matter has been collected by the author which has never been brought together before, but is of importance in a general consideration of the subject of secretion. Rather more than half the book deals with external secretion; the remainder is a short summary of the histology and processes of internal secretion.

The author reviews the methods which have been adopted for the investigation of the problems of internal secretion, and has some wholesome criticism to make of modern "organotherapy," a practice which is based upon the assumption that the active substance of the gland is absorbed unaltered into the circulation when administered by mouth. It may be objected that Prof. Swale Vincent is too critical, but in the absence of experimental proof that preparations of the ductless glands, other than thyroid, and, to a much less extent, the active substance of the Islets of Langerhans of the pancreas, have any action when administered orally, his is the only scientific attitude.

In regard to internal secretion generally, Prof. Swale Vincent also sounds a note of caution. It is by no means proved that all the organs classified as endocrine really exert their influence by secreting active substances into the blood, and because this is found to be true of one gland it does not follow that all act in a like manner. The parathyroids are specially mentioned as furnishing an example of a gland which, while it influences metabolism in certain directions, may do so, not by an internal secretion, but by an action comparable to that of the liver cells in their influence upon protein metabolism. One feels that the probability of action by an internal secretion is greater in the case of small glands like the parathyroids, but no harm is done in stressing the fact that much is assumed without proof in regard to the supposed functions of some of the ductless glands

(3) Dr Vines has undertaken a difficult task in compiling a monograph upon the parathyroid glands. The difficulty lies in the conflicting views which are held as to their functions At one time the parathyroids were confused with the thyroids, and most of the older literature is permeated with this error. More recent views regard the glands as playing some ill-defined rôle in the metabolism of calcium salts, or as concerned with the detoxication of certain nitrogenous bodies, such as guanidine, normally formed in metabolism Dr Vines assigns both functions to the parathyroids, and considers they are carried out by different means He gives an excellent summary of the different views put forward, and references to the more important original papers on the subject His conclusions, however, do not always carry conviction upon the evidence produced

Dr. Vines recognises that the means whereby calcium metabolism is controlled are very obscure and that other ductless glands may be involved. The evidence that the parathyroids are specially involved in calcium metabolism is far from satisfactory. The proofs of their having a detoxicating influence upon guanidine are more certain, and Dr. Vines has elaborated a method of testing this action *in vitro* A table is given showing the considerable variations which he found by this means in the activity of commercial preparations of parathyroid. The possible inactivity of parathyroid preparations is freely discussed, as also is the fact that parathyroid feeding in normal animals has no definite physiological effect Dr. Vines does not agree with Prof. Swale Vincent that parathyroid therapy is therefore worthless, and gives experimental evidence that parathyroid feeding, even in small doses, has a distinct effect both in diminishing an excess of guanidine in the blood and in promoting an increase of calcium salts in the plasma of the human subject in certain pathological conditions

The difference of opinion is a fundamental one Dr. Vines claims that a negative effect of parathyroid is to be expected in the normal animal, for in such case guanidine is not present in excess in the blood. Insulin, the active principle of the Islets of Langerhans of the pancreas, has a very potent effect upon the normal animal where there is no excess of glucose in the blood, but the analogy may not be a fair one. Until much more is known about the mode of action of the parathyroid and the nature of its active principle or principles, it is unsafe to express definite opinions Such criticism is inevitable in the present lack of knowledge about the parathyroids, but is not intended to detract from the value of the work of Dr. Vines, who has rendered a distinct service to medicine in issuing this volume P. T H

A Composite Work on Physical Chemistry.

A Treatise on Physical Chemistry. A Co-operative Effect by a Group of Physical Chemists. Edited by Prof Hugh S. Taylor In 2 vols. Vol. 1. Pp xi+603+41. Vol. 2. Pp. ix+701-1359+41 (London: Macmillan and Co, Ltd, 1924.) 50*s*. net.

WHILST the group method of writing has in the past been confined almost exclusively to treatises in various branches of medicine and surgery, Prof Taylor is to be congratulated on a most successful application of the method to physical chemistry. This subject, which unfortunately for Great Britain did not develop with such rapidity as its sister subjects pure chemistry and physics, is now entering a period of a new revival which renders the appearance of this work most opportune. It is interesting to note not only a number of British nationality among the seventeen contributors to the various chapters, but also that uniform English spelling is adopted.

The volumes are conveniently so divided in subject matter that the first volume forms the basis for developing the more fundamental laws and properties of matter, whilst in the second a more advanced and in certain portions a somewhat speculative treatment of some of the newer aspects in the development of physical chemistry is presented

Prof. Taylor has almost achieved the aim of the ideal editor in forming a composite text-book without serious change in either the standard or style of treatment from chapter to chapter. The treatment of the gaseous and liquid states of aggregation in the first volume, and of colloid chemistry in the second, might possibly be singled out as somewhat inadequate, whilst the chapters on the solid state of aggregation and electrical conductance in the first volume, on the electro-chemistry of solutions, catalysis and the quantum theory in physical chemistry in the second volume, are really good both in clarity of expression and in the range of material covered.

The text is remarkably free from misprints, of which perhaps the most striking is Helmholz for Helmholtz, whilst Debrouste, p. 133, should surely read Labrouste

In a book of this character a certain amount of repetition is unavoidable; one might suggest that perhaps a little too much space is given in the first volume to the discussion of Henry's law, which appears both on p 238 and p. 344, and to the now exploded radiation theory of chemical change in the second.

In discussing dilute solutions in the first volume, the student is led on to the concept of activity and potential functions. If such a treatment were extended to the introduction of the phase rule, p 367, the reading by

the student of books specially devoted to this subject would be greatly facilitated, whilst the plotting of the temperature as abscissa in the phase diagrams (Figs. 23 and 29) does not seem a very happy innovation.

It is a pity that the erroneous conceptions concerning the determination of the surface tension of solutions by the drop weight method are finding a place in standard text-books Harkins' extension of Lohnstein's work on this subject might well be replaced by that of Iredale in a future edition

The important paper of Debye and Huckel on the ionisation of strong electrolytes has been largely utilised in the second volume, and it would form a good substitute for the discussion of the erroneous hypothesis of Ghosh, to which three pages are devoted in Chapter xi. Also, in view of the ever-increasing importance of the amphoteric electrolytes, such as the proteins, a more detailed discussion of some of the electrical properties of such substances would not be out of place In the chapter on colloid chemistry, Antonov's important rule and the alternative forms of the Gibbs' equation for non-ideal solutions might well have been included.

One of the most valuable features of the book is the inclusion of a number of experimental methods, together with a discussion on the probable and possible errors in physical chemical measurements, which serves not only to emphasise the need for consideration of the accuracy of measurements obtained in the laboratory, but also assists the student in visualising the subject both in its theoretical and its practical aspects.

Prof Taylor, his co-workers, and the publishers are to be heartily congratulated on the production of this text-book, which, at any rate on the desk of the reviewer, will replace all others

ERIC K RIDEAL

Our Bookshelf.

Atomtheorie in elementarer Darstellung Von Prof Dr Arthur Haas. Pp viii + 204 + 2 Tafeln (Berlin und Leipzig: Walter de Gruyter und Co, 1924) 5·40 gold marks

DR. HAAS is a gifted exponent, with a particular talent for compression In this book of some two hundred pages he deals with the experimental establishment of the existence of the electron, the quantum theory of spectra, the modern work on X-rays and crystal structure, isotopes, and, in short, all that fascinating body of modern work which centres round the structure of the atom. He touches on such details as the selection principle of Sommerfeld and Landé, with its inner quantum number, the metastable state of the helium atom established by Franck, and the quantum theory of band spectra. There are, of course, only a few words devoted to each of such subjects, but these words are always pertinent and well chosen, and reveal the essence of the results obtained Bohr's work of the last few years on the grouping of electrons in the general atom, and the interpretation of the periodic table in terms of quanta, is handled at comparative length, the periodicities revealed by the X-ray terms and the bearing of the spectra of potassium and calcium on the electron grouping in the first long period being well explained The book concludes with an eight-page summary of its contents

Dr Haas is particularly concerned with the quantum theory of optical spectra, and devotes comparatively little space to the work of Rutherford and his school on scattering and disintegration, and the work of Aston on isotopes, although, of course, this is not to say that these aspects are entirely neglected The general exposition is excellent, although the comprehensiveness of the scheme and the shortness of the book necessarily entail a certain abruptness For a reader already acquainted with some of the fundamental methods and results of the quantum theory, but yet not a specialist in this field, the book offers a very agreeable means of revising his knowledge and extending it in certain directions While the physicist will appreciate the review which the book affords, it is possible that the chemist and the layman, whom the author mentions in his preface, will find the simplicity which the lack of mathematics appears to lend to the book somewhat deceptive The book has, however, many great merits: it is original in selection and arrangement of matter, concise in expression, includes very recent work, and is written with a knowledge and appreciation which are abundantly evident.

E. N. DA C. A.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. 28 *Refractory Materials: Fireclays. Analyses and Physical Tests.* By F R Ennos and Dr Alexander Scott Pp iv + 84 (Southampton Ordnance Survey Office, London: E Stanford, Ltd, 1924) 3*s*. net.

THIS report is intended to supplement volume 19, the well-known report on refractory materials. Volume 28 contains notes on the mode of occurrence of fireclays; analyses of about 250 fireclays, and the results of tests on the refractoriness, porosity, tensile strength, and contraction of about 70 clays. The refractory tests for about 50 clays are applied to Ludwig's chart with very fair success To this it may be added that there is generally a difficulty in interpreting the fusion temperature of a fireclay No specification is able to give clear unequivocal instructions as to when a fireclay exhibits "signs of fusion" Discrepant results by different observers show that the "signs" are interpreted differently by different men This also may explain some difficulties encountered in the general use of Ludwig's chart

The novelty in the report is the statement that "probably the simplest and most useful chemical method of estimating the refractoriness of fireclays such as those investigated is to determine the combined water." The evidence plotted on p 72 is far from convincing From this it would be inferred that a fireclay with between $5\frac{1}{2}$ and 12 per cent of combined water would have a refractoriness of cone 28, or, taken from another angle, a clay with 5 per cent. of combined water might have a refractoriness extending from cone 10 to 26! It will be necessary in the next edition to

show in what way the proposed novelty can be of any use whatever. It is claimed that the "report should prove to be a convenient work of reference in the brick-making and refractory-using industries" This claim will be abundantly justified; the Geological Survey is to be congratulated on the utility of these Special Reports. J. W MELLOR.

The Pharmacists' Botany By Dr. George B. Rigg. Pp xvii+303. (New York: The Macmillan Company, 1924) 16*s*. net.

MANY of the drugs in common use as medicines are derived from the vegetable kingdom, and are to a great extent supplied to the public by the pharmacist, who has to guarantee their identity and freedom from adulteration. For this reason the pharmacist is required to undergo an adequate training in the science of botany, for which a number of excellent text-books have been published, and institutes exist in which lectures and instruction in practical work are available. Indeed, so large is the number of text-books that it is difficult to understand the necessity for an additional one unless it presents the subject in a manner specially adapted for a particular class of students Prof Rigg says that his aim has been "to include not only those phases of botany that are of specific use to the pharmacist, but also to give a general view of the subject which will serve as a background for him in his professional work."

A knowledge of the morphology and anatomy of the parts of plants used in medicine is particularly essential to the pharmacist, and in these respects a pharmacists' botany should give fairly complete, accurate, and precise information Prof. Rigg's book does not satisfy this condition; and inaccurate statements occur so frequently as to constitute a serious blemish The book is well printed, and is illustrated by a number of photographs which, for the most part, answer the purpose for which they are employed It cannot, however, be recommended for pharmaceutical students or pharmacists until it has been thoroughly revised, erroneous statements corrected, and the details more systematically arranged.

Penrose's Annual: the Process Year Book and Review of the Graphic Arts Edited by Wm. Gamble Vol. 27. Pp. xv+142+60+80 plates. (London: Percy Lund, Humphries and Co, Ltd, 1925) 8*s*. net

ALTHOUGH, as stated in the review of process work, there has been no outstanding achievement during the past year, the editor has provided a very pleasing and useful volume, as his custom is The making of half-tone blocks seems to have arrived at a degree of perfection that it is very difficult even if possible to surpass, though the method may perhaps be simplified by the efforts made to render it more systematic Rotary photogravure is being applied to multicolour printing, and the method is being successfully worked on sheet-fed machines producing excellent work up to speeds of 2500 copies per hour for each colour A higher output may be expected from the same cylinders when rotary web machines are available. The replacement of the costly solid or tubular copper cylinders used for rotary gravure by iron cylinders faced with thin copper sheets has considerably advanced during the year.

The type used for the letterpress of the volume appears to be a modern reproduction of the Aldine type of the Hypnerotomachia Poliphili issued in 1499, concerning which there is an introductory article. The private press dealt with in an illustrated article is this year the Daniel Press owned by the late Rev C H. O. Daniel, of Oxford. Among the very numerous illustrations is a series of examples of posters, mostly in colours, twenty-four reproductions of the celebrated woodcuts of the 'sixties, many examples of offset printing and of colour work, all of which are excellent and of considerable technical interest, and some admirable also because of the beauty of the originals

A Bibliography of Printed Maori to 1900 By Dr. H W. Williams (Dominion Museum Monograph, No 7) Pp xvi+198. (Wellington, N Z W A G. Skinner, 1924) n p

DR WILLIAMS' bibliography of printed Maori publications contains nearly 1100 items The mere number, however, does not nearly represent the amount of labour which has been expended in its compilation, as each entry is annotated with information additional to the formal particulars, and in many cases some indication is given of the character of the contents The author has departed from the strict rule followed by many bibliographers and has included items which he has not personally examined, but as such entries are indicated, those who use the bibliography will in these cases be on their guard The entries are in chronological order —a disadvantage if the date of the book about which information is sought is not known, or if it is undated —but as the entries are naturally of a very miscellaneous character, ranging from Bibles and prayers to newspapers, dictionaries, and government documents, any satisfactory classification would be a matter of extreme difficulty Further, the deficiency is to some extent made good by a very full index and a list of authors and translators In the preface, Dr Williams reviews previous attempts at Maori bibliography, and his introduction is a valuable account of Maori presses in which the work of the various missionary societies, both in reducing Maori to a written language and in printing it, is fully recognised The first book to be printed in the language was "The New Zealander's First Book," by Thomas Kendall, the missionary (1815), for the instruction of the natives It is, Mr Williams says, scarcely to be recognised as Maori at all.

An Introduction to the Mathematical Analysis of Statistics By Prof. C H Forsyth Pp viii+241. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1924) 11*s*. 6*d*. net.

THIS work is intended primarily as a text-book for a course in mathematics and not as a reference book for the statistician It is to be doubted, however, whether the mathematician as such will be quite satisfied with it In its scope it is modest, commencing with useful chapters on numerical computation, finite differences, and interpolation, and proceeding by easy stages through probability, averages, a treatment of the normal frequency curve, to correlation. While there are copious and useful examples, the mathematical treatment is patchy and uneven, it is a useful, interesting, but unsatisfying production.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications.*]

The Ages and Masses of the Stars.

SOME of the questions raised by Prof Lindemann's interesting letter (NATURE, February 14, p 229) can, I think, be answered at once out of our present store of astronomical knowledge

The sun radiates in round numbers two ergs per second for every gram of its mass, a total of 4×10^{33} ergs a second, of which $1\ 7 \times 10^{24}$ ergs fall on the earth If the earth had no other source of energy, it would radiate away $1{\cdot}7 \times 10^{24}$ ergs per second from its $5\ 1 \times 10^{18}$ sq cm of surface, and this would keep the surface at an average temperature of 276° abs or 3° C This about accords with the facts If the earth's surface is not a perfect radiator the argument is slightly different but the final result is the same If, however, the earth generated energy at the rate of even a thousandth of an erg per second for each gram of its mass, it would have to radiate away $7\ 7 \times 10^{24}$ ergs a second, requiring the quite inadmissible surface-temperature of 131° C or more in so far as the earth's surface is not a perfect radiator Even a generation of a 10,000th of an erg per gram per second, requiring a surface-temperature of 29° C or more, would seem to be out of the question

Clearly, then, the mechanism which produces the sun's radiation is absent from our earth, or at best acts very feebly under terrestrial conditions In giant stars, on the other hand, the mechanism is either more abundant or more potent As against the sun's radiation per gram per second of 2 ergs, the bright component of Capella radiates 30 ergs, α Orionis about 200 ergs, *V* Puppis over 300 ergs, and Canopus probably over 1000 ergs

This leads on to Prof. Lindemann's problem as to how the generation of energy per unit mass, E/M, depends on the temperature and density I think the examples just given suffice to show that E/M is not a function either of the temperature or of the density, which is what ought *a priori* to be expected if the annihilation of matter is the source of energy. The energy transformed into radiation when an electron drops into a nucleus is about 0 003 erg, or a quantum of wave-length $6\ 55 \times 10^{-14}$ cm, corresponding to a temperature of $1{\cdot}5 \times 10^{13}$ degrees. For the production of effects of this intensity, it is scarcely likely to make much difference whether the atomic temperature is 10^6 or 10^7 degrees

The only satisfactory hypothesis I have been able to frame is that E/M in a star is a function of the state of development of the star This hypothesis seems to fit all the facts; it would itself be explained if we could suppose matter as originally created to have consisted of a mixture of different types, some of which annihilated themselves rapidly, some only slowly, some perhaps not at all As matter aged, the more destructible types would disappear, and the whole mass would in time consist only of the less destructible and non-destructible varieties In a paper read at the January meeting of the Royal Astronomical Society, I showed that this supposition explains the observed facts of the giant-dwarf theory, indeed it seems almost to be demanded by these facts. We have to suppose that only the non-destructible or almost non-destructible varieties of matter are left on our earth, so that there must be kinds of matter in the sun and stars of which we have no knowledge

The matter of which the earth is formed must, however, be of the same age as that of the sun. Whence, then, the enormous disparity in the two values of E/M? The only answer appears to be that the matter which formed the earth was not a fair sample of the solar substance On any theory of its origin, the earth must have been formed from the outermost layers of the sun, so that we have to suppose the more destructible parts of the sun's substance to have been confined to its central regions; the heavier elements in the sun must have been more destructible than the light elements which were skimmed off to form the earth

This leads to a consistent and comparatively simple scheme The heaviest element known on earth is uranium of atomic number 92, but no known reason compels the series of elements to stop abruptly at N = 92, and we may quite well suppose that in the sun there were, and still are, additional elements of higher atomic numbers It is easily calculated that the nuclei of these elements cannot be entirely stripped of electrons, indeed the ionisation potential for the last electron in the uranium atom is about 230,000 volts, corresponding to a temperature of about 17×10^8 degrees (for resonance, 170,000 volts and 13×10^8 degrees) In elements heavier than uranium the quantum orbit (∞, 1) which approaches nearest to the nucleus comes so near as almost, if not quite, to touch Even in uranium, as Rosseland has pointed out (NATURE, March 17, 1923), the distance of nearest approach is only $1{\cdot}5 \times 10^{-11}$ cm, which cannot be much greater than the radius of the uranium nucleus (cf. Neuburger, *Ann d Phys*, 70 (1923), p 145) Thus the atomic number 92 may well mark the division between atoms in which the electron orbits are all clear of the nucleus and those in which collisions, or at least very close encounters, between electrons and nucleus are possible The mechanism of annihilation of matter may be found in these collisions or close encounters between electrons and nucleus, in which case atoms of atomic number 92 and less may be immune It should, however, be noticed that if the rate of annihilation is strictly independent of the temperature, the quantum orbit (∞, 1) cannot be involved, and annihilation must result from spontaneous drops from orbit 1 to orbit 0, as I originally suggested in NATURE (December 6, 1924) In any case we are free to suppose that matter as originally created consisted of elements of atomic numbers both above and below 92, but that electronic annihilation reduces the number of electrons in the heavier atoms until finally only atoms of atomic number 92 or less are left

This brings us to a solution of Prof Lindemann's first problem: to explain the existence of uranium on earth in view of its comparatively short half-life period of 6×10^9 years Before the earth was born we imagine the heavier elements in the sun having their atomic numbers lowered by the annihilation of electrons, and emitting radiation in the process. A certain amount of uranium would be created out of the heavier elements by their degradation and probably also, as Prof Lindemann suggests, a further (and much larger) amount out of the lighter elements by nuclear photosynthesis The amount of uranium present in the sun would be determined by the condition that the total rate of creation should equal the rate of decay by ordinary radioactivity.

When the earth was formed out of the sun's uppermost layers, the creation of uranium would cease in the earth, for the supply of heavier elements would be cut off, as also the supply of radiation of high enough frequency to produce uranium photosynthetically The earth's store of uranium would now gradually disappear by ordinary radioactive disintegration. But Prof Lindemann's upper limit of 6×10^{11} years now appears merely as an upper limit

to the time since the earth was born out of the sun. By a more detailed but similar calculation Prof H N Russell has estimated this upper limit at 3×10^{10} years (Proc Roy Soc, 99 A (1921), p 86)

Our hypotheses doubtless suffer from over-precision, and a more general discussion might permit of a greater age for the earth It does not seem to me that the presence of uranium and thorium discloses any insoluble difficulties, although it would obviously have been more gratifying if the earth's age had come out a larger fraction of the estimated age of the sun

J H JEANS

February 16.

Robert Browning as an Exponent of Research.

THE comment in NATURE of January 10, p 58, on poets who have touched the field of science may fitly be supplemented by some reference to Robert Browning, whose utterances in this field are often overlooked, although he has shown a deeper insight into the spirit of research than any other poet known to me, and has expressed it many times in glowing words This trait is the more remarkable since Browning evidently knew little and cared little about the particulars of science, and probably found them somewhat repellent, being in this respect widely different from Tennyson, who was well versed in the scientific literature of his day, and used his knowledge of it freely Yet Tennyson's attitude remained always that of the orthodox cultured "naturalist" of Victorian times, skilful in observation, but recoiling in alarm from the outlook to which observation led Browning on the other hand took little heed of the path, but pressed on boldly toward the outlook and gauged the qualities required to reach it Even in his conception of a poet, as expressed in "How it Strikes a Contemporary," he sees an investigator pure and simple, with an aptitude for understanding and recording vividly pictured in the person of the elderly man of Valladolid, the true "Corregidor" of the city, whose

"—very serviceable suit of black
Was courtly once and conscientious still",

who

"—walked and tapped the pavement with his cane,
Scenting the world, looking it full in face";

everywhere taking such keen "cognisance of men and things" that you might even

"—surprise the ferrel of his stick
Trying the mortar's temper 'tween the chinks
Of some new shop a-building—"

The most frequently quoted though scarcely the most cogent expression by Browning of the spirit of research is contained in that noble threnody "A Grammarian's Funeral," which ought by now to have drawn from some great composer a stately "Searcher's Funeral March." It is unnecessary to recall the many familiar passages—the whole poem is an emotional rendering of delight in the pursuit of knowledge, and pride in its acquisition, whether the apparent gain be great or small

"He settled *Hoti's* business—let it be!—
Properly based *Oun*—
Gave us the doctrine of the enclitic *De*"

—achievement enough for a Hymn of Triumph

Browning's power in the field of psychology has always been recognised, though his psychology is, of course, tinged deeply with emotion, as in that celebrated and much-discussed example "The Ring and the Book" His grip of the scientific mentality is perhaps nowhere better displayed than in his subtle analysis of the mind of an investigator confronted with a supernormal phenomenon, given under the guise of "An Epistle," from Karshish, the vagrant Arab physician—

"—the picker-up of learning's crumbs,
The not-incurious in God's handiwork,"

to his Sage at home—

"To Abib, all-sagacious in our art,
Breeder in me of what poor skill I boast"

Antique in form but modern in application, the "Epistle" reveals the imagined writer as the possessor of exactly the mental qualities which would do credit to a young travelling medical man of the present day

This appreciation of research is not, however, noticeable in Browning's earlier poems, one searches vainly for any clear expression of it in "Paracelsus," where one might expect to find it, but it crops up again and again, with increasing intensity, in his later work, and often in unexpected places Take this, for example, from "Apollo and the Fates"—

"—'Tis Man's to explore
Up and down, inch by inch, with the taper his reason;
No torch, it suffices—held deftly and straight
Eyes, purblind at first, feel their way in due season,
Accept good with bad, till unseemly debate
Turns concord—"

Or this, again, from "Fust and his Friends"—

"—Man Ignores—thanks to Thee
Who madest him know, but—in knowing—begin
To know still new vastness of knowledge must be
Outside him—to enter, to traverse, in fee
Have and hold! 'Oh, Man's ignorance!' hear the fool whine!
How were it, for better or worse, didst thou grunt
Contented with sapience—the lot of the swine
Who knows he was born for just truffles to hunt?—
Monk's Paradise—'*Semper sint res uti sunt!*'
No, Man's the prerogative—knowledge once gained—
To ignore,—find new knowledge to press for, to swerve
In pursuit of, no, not for a moment attained—
Why, onward through ignorance! Dare and deserve!
As still to its asymptote speedeth the curve,
So approximates Man—Thee, who, reachable not"

Is it not by glowing rhapsody of this kind, rather than by the rendering in verse of specific results in science, be it ever so skilfully and accurately, that the poet can best touch the imagination with a sense of what science is, and may be? G W LAMPLUGH

St Albans, January 31

The Origin of Sponge-Spicules.

IN the preliminary account by my friend Prof Dendy (NATURE, February 7, p 190) it is difficult to see evidence for the independent organic life of his "scleroplastids" There is nothing to prove this hypothesis in the observation that the first rudiment of the spicule in Stelletta is a skeleton-crystal on the tetrahedral system, afterwards overlaid (as we have long known in the tetracrepid desma of Lithistida) with siliceous deposit in amorphous aggregation Obviously twinning and repetition of branches (also long known) are not arguments against the crystalline character of form in spicules In 1898 I pointed out certain resemblances to the relations between a symbiotic organism and its host in the relations between a crystal, utilised as a spicule, and the sponge which has secreted it (Proc Roy Soc, vol 64, p 71) These resemblances seem to have misled Prof Dendy to his new theory, but he adduces no facts which give evidence for separate organic life in the spicule, or impeach the evidence for its crystalline structure

I advocated crystallographic explanation of their

symmetry for siliceous as well as for calcareous spicules (*l c* p 70), and the brusque reply then often given that " opal is a colloid " would scarcely now be tendered Minchin, who at that time followed Schulze in thinking the form of spicules a result merely of the geometry of the canal-system, later accepted the crystallographic theory for calcareous and hexactinellid spicules, though not for those of Demospongiæ (1905, *Zool Anz* , 1908, *Q J M S* , 1909, *Ergebn u Fortschr Zool* , ii pp 251, 265)

Later work on suberitids, and on the sponge the name of which Prof Dendy has strangely changed to Donatia, has convinced me that the case is as strong for these sponges as for the hexactinellids The Suberitidæ, though included by Prof Dendy in his hospitable group of Tetraxonida, have triaxon spicules, while Donatia shows very interesting evidence of tetraxon crystallisation The conjecture is possible that crystallisation takes place on the tetrahedral system when the spicopal contains 6 per cent of water in chemical union (Siphonidium, Sollas, 1888 , Geodia, Butschli (Jannasch) 1901) and on the cubic system when it contains 7 per cent of water (Suberites, Sollas, 1888 , Poliopogon, Schulze (Moly) 1887), which might be complementary (cf Sollas) to $(SiO_2)_5$ and $(SiO_2)_4$ respectively

I welcome in paragraph (1) [second series of numbers] the word " Mendelian " as showing that our foremost systematist recognises now that the sponges which he investigates are not guaranteed to be thorough-bred Classifiers in general have taken too little account of the *prima facie* promiscuity of the ocean, and for the innumerable " species " of sponges which infest our books " hybridisation must play great part in the characters we laboriously tabulate " (Bidder, Journ Linn Soc , vol 34, p 302) If Prof Dendy will recognise also that the existence and character of spicule-forms can be modified in the individual as the direct physiological consequence of changes in the chemical constituents of sea-water, in temperature, or in light, the nomenclature in his admirable monographs may become simpler

As regards the independent genesis of spicules, the last sentence of Prof Dendy's letter indicates that he has not observed " scleroplastids " outside cells, and I cannot see that the remainder offers any evidence that they originate outside cells , though I know no reason against silica being deposited in the interstitial jelly of sponges, as lime is in vertebrate cartilage Physiologists have not thought it necessary to suggest that we should recognise as symbiotic bacteria the calcareous granules in the ground-substance of cartilage, or in other tissues the crystals of urate of soda " which are at first gelatinous, but become crystalline " (Noel Paton, Enc. Brit , 18, 137) like Prof Dendy's " scleroplastids "

GEO P BIDDER

Cambridge, February 14

Instability of Viscous Fluid Motion.

BY the courtesy of Mr C S Elton, Dept of Zoology, University Museum, Oxford, the writer has seen photographs taken at Spitsbergen of loose stones on mud flats forming striking patterns of polygons On inspecting these photographs, Capt D Brunt of the Meteorological Office at once recalled a paper by Rayleigh " On Convection Currents in a Horizontal Layer of Fluid " (*Phil Mag* 1916) The present writer in turn recalled Bénard's thesis on the same subject (Gauthiers-Villars, Paris 1901)

On referring to these papers, it was found that Rayleigh in fact gives an approximate mathematical theory of Bénard's experimental work, and shows that where a vertical flow of heat produces a temperature and density gradient in a horizontal layer of fluid, an apparently unstable arrangement, with greater density above, acted on by gravity, may actually be stable until the relation is satisfied,

$$\rho_2 - \rho_1/\rho_1 > 27\pi^4\kappa\nu/4gh^3,$$

where ρ, κ, ν, h are the density, conductivity, viscosity and depth

Multiplying both sides by $gh\rho_1/6$ and dropping the suffix to denote that the mean density may be taken, we get,

$$gh(\rho_2 - \rho_1)/6 > 27\pi^4\kappa\nu\rho/24h^2$$

The expression on the left-hand side is the energy released by inverting the fluid so that the density gradient downward is the same as the original gradient upward This expression may be used as an approximation even when the gradient is not linear

When the critical gradient upward is exceeded, instability must appear, at first in a chaotic manner , but certain modes of motion have greater rates of increment characterised by the (real positive) value of q in the factor exp (qt), and these modes finally prevail over all others

When the bottom boundary is a solid surface, and the upper boundary a free surface, the chance centres of instability seem always to form on the solid boundary, and to send up threads of fluid vertically which reach the surface and there spread out on all sides until they meet the neighbouring outward flows These meetings determine boundary sheets also vertical or nearly so, down which return flow takes place, the circulation being completed along the bottom

Polygonal prisms are thus formed in each of which circulation takes place The number of sides may be 3, 4, 5, 6, or 7 The triangles are rapidly crushed out of existence, the squares follow more slowly, and if the conditions are kept sufficiently uniform, hexagons finally cover the whole surface with great regularity of form and size

If, however, there is a general flow, v, across the plane, the vertical threads are drawn out into vertical sheets parallel to the v-flow The return flow also takes place downwards along vertical sheets parallel to the former These sheets divide the layer into long compartments of rectangular cross section

The problem becomes two dimensional, and the motion of instability takes the form of u-w flow in closed paths within the compartments formed by the sheets The most vigorous mode is with the distance between adjacent sheets, one rising, one descending, equal to the depth

When the v-flow comes to rest, cross divisions appear forming squares on the surface, the most vigorous mode for squares being with side $2\sqrt{2}$ times the depth according to the theory, but before there is any sign of this being reached the squares give way to the more vigorous hexagonal mode There is no mathematical solution available for the hexagon, but we may infer from experiment that when the mean diameter is from three to four times the depth, the hexagonal mode is more vigorous than all others

In applying these results to the stone polygons on mud flats, it may be remarked that the ground, deeply frozen in winter, thaws superficially in summer to a depth varying from a few centimetres upwards. The frozen surface beneath is called the ground ice, and is at 0° C in the absence of salt water The density of the water will therefore increase upwards with temperature until 4° C is reached When we consider the solid matter in suspension, the mixture will have complicated properties in respect of proportion of water, mean effective density, conductivity, specific heat and viscosity, and attempts to form a quantitative estimate of the condition of instability

meet with a formidable array of unknown quantities According to the theory, however, only a trivial gradient is required for depths exceeding a decimetre to produce instability, and slowly it may be, but in the long run inevitably, the water must circulate, sorting out the lighter materials and conveying them to the polygonal boundaries of the downward flow

On these assumptions the following predictions were made

(*a*) That the surface would not depart much from the temperature of maximum water density, 4° C

(*b*) That in the absence of stones which were merely indicators of the motion, polygonal marks would be formed on the mud

(*c*) That where the mud flowed down gentle slopes, lines of stones would be formed parallel to the flow, but that where the mud came to rest, cross divisions would appear forming rectangular divisions which would give place later to polygons

(*d*) That the diameters of the polygons would be from three to four times the depth

(*a*), (*b*) and (*c*) were confirmed by Mr Elton, and (*d*) was in accordance with rough observation, the depth being about a metre, the mean diameters about three or four metres

Mr Elton has since written that according to B Hogbom, from whose paper "Ueber die geologische Bedeutung des Frostes" (*Bull d geol Inst Upsala*,

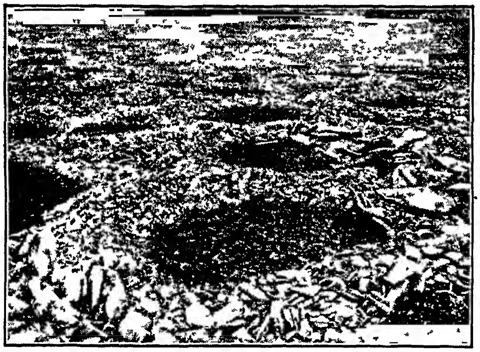

FIG. 1 —Stone Polygons on Erdmann's Tundra, Icefjord, Spitsbergen

vol xii 1914), the illustration (Fig 1) is reproduced, an explanation based on Bénard's work was put forward by Otto Nordenskiold in "Die Polarwelt und ihre Nachbarlaender" (Leipsig und Berlin, 1910), but was withdrawn in a paper in the "Wiss Ergebn d. Schwedische Sudpolarexpedition" 1911 Mr. Elton also gathers from a paper by Huxley that Eakin (U S A Geological Survey Bulletin, No 631, 1916) has proposed a similar explanation

On applying an arithmetical comparison between Rayleigh's criterion and Bénard's experiments, it appears that instability sets in with less than one-tenth of the gradient required by theory The fluid used was melted spermaceti, for which the viscosity and conductivity are not known, and for this and other reasons connected with the mounting of the experiments, the comparison is not satisfactory

Of more general interest is the application of the criterion to the atmosphere Using the value of $\kappa = 5\nu/2$, given by the kinetic theory of gases and assumed by Rayleigh, the following table of temperature departures from the adiabatic lapse of neutral equilibrium is obtained

Depth of layer	1 cm	1 m	100 m
Temperature difference in excess of adiabatic	9° C	9° C $\times 10^{-6}$	9° C $\times 10^{-12}$

To account for observed stable layers in the atmosphere with a lapse rate far exceeding the adiabatic for many metres, it is necessary to look for an effective conductivity far exceeding the slow diffusion of the kinetic theory, and this may possibly be found in radiation and absorption, which account for the transfer of heat on an immensely greater scale. Convection of heat is excluded by the assumption of stability

Even if stability breaks down almost instantaneously, the modes of instability will still be controlled by the considerations discussed above, but further comment must be left to meterologists

It is remarkable that an analogous criterion may be extended to Prof G I Taylor's experiments on the stability of fluid motion between coaxial circular cylinders rotating with given angular velocities ω_1, ω_2 If r is the radius, $\omega r = v$ the velocity perpendicular to radius and axis, then the equilibrium of a perfect fluid rotating steadily about the axis is stable, neutral, or unstable as vr increases, is constant or decreases radially outwards

If a particular value of vr were an inherent permanent property of each element, the same statement would be true for a viscous fluid But just as the density gradient in Bénard's experiment is due to the flow of heat, so here the vr gradient is due to the diffusion of v according to the relations for heat transmission, from the faster moving cylinder to the other.

Both the two dimensional case above and Taylor's case come under Rayleigh's extension of Helmholtz's theorem of minimum dissipation, so that the steady dissipation due to the not necessarily small v-motion, and the additional dissipation due to the small u-w motion are independent Thus we have merely to replace $\kappa\nu$ by ν^2 and the analogy is applicable at once

Rayleigh has pointed out that with two fixed solid boundaries, the effect of viscosity in increasing the dissipation will be increased In the simple case of laminar motion v across a plane with one free surface, the dissipation is increased four times, for the same mean v, when a second fixed surface takes the place of the free surface

Taking this as an approximation to the effect in the more complex case of u-w circulation, the criterion becomes

Energy released by inverting the vr gradient radially $> 27\pi^4\nu^2\rho/6h^2$, i e four times the previous value

In this form the boundary line between stability and instability in the ω_1, ω_2 plane is found to be a hyperbola in accordance with Taylor's result, and the diameter is given with an accuracy which is perhaps a trifle fortuitous

So far this holds only when ω_1, ω_2 have the same sign When they are of opposite signs, nodes may appear in the u-w circulation, and it becomes necessary to introduce terms of the form $\sin(2\pi z/h)$ as well as of the form $\sin(\pi z/h)$ corresponding to the gravest mode of instability which alone Rayleigh considered

Enough has been done to allow the analogy between the two-dimensional case worked out by Rayleigh, and Taylor's case to be drawn in full detail

There are many applications of the criterion which suggest themselves, and seem to make it worth while to bring forward this provisional discussion for wider consideration A. R. LOW.

The Library, Air Ministry,
London, December 29

THE experiments of Bénard, and the theoretical discussion by the late Lord Rayleigh, referred to by Major Low, deserve careful consideration from the point of view of their application in meteorology. Rayleigh showed that a layer of fluid can remain

stable, even with the denser fluid above, in virtue of its conduction and viscosity In the atmosphere it is customary to regard stability as associated with a fall of temperature with height limited by the adiabatic lapse-rate, 1° C per 100 metres for dry air, a greater lapse-rate, or fall of temperature with height, denoting instability. It is, however, an accepted fact that lapse-rates greatly in excess of this value are of frequent occurrence, especially in the lowest 10 or 20 metres, at which height they can be observed at some time of day on almost any day of the year

An analogy with Rayleigh's result suggests that these large lapse-rates are able to exist only in virtue of the viscosity and conduction of the air When, however, we put figures into Rayleigh's formula, we find that in a layer 10 metres thick, the lapse-rate could not exceed the adiabatic by more than a very minute fraction But Rayleigh's treatment only deals with conduction in the strict sense, the coefficient of conduction for air being derived theoretically from the kinetic theory of gases Now in air the transfer of heat by radiation is enormously greater than by molecular conduction, and for air we should therefore use some higher factor than the ordinary coefficient of conductivity κ in Rayleigh's formula An attempt is being made to derive an expression corresponding to that of Rayleigh for a compressible fluid, taking into account the various factors outlined above

When we come to discuss the form of circulation which enters when the equilibrium breaks down, we find several examples in meteorology. The cellular form in which the breakdown of the unstable arrangement takes place is most clearly shown in mammato-cumulus clouds A very fine example of this type of cloud is shown in a photograph by Dr W J S Lockyer, reproduced in NATURE for November 17, 1923, p 725 This type of cloud was further discussed by Dr G C Simpson in NATURE for January 19, 1924, p 82 Such clouds occur usually in the rear of thunderstorms where there is a general slow settling of air If there is in this region a layer of cloud or damp air, with a layer of dry air beneath it, then, as pointed out by Dr Simpson, in consequence of the descent the dry air is warmed adiabatically at a higher rate than the damp air, and instability results The small cloudlets are comparable with the polygonal prismatic compartments of Bénard's experiments

There is one possible difference, in that in Bénard's experiments the lower boundary of the fluid is a solid surface, and the circulation in each compartment is upward at the centre In the case of the unstable layer which forms the mammato cloud, the boundaries above and below are interfluid surfaces, and it is possible that the circulation in the individual cell is in the reverse sense to that of Bénard There is no obvious criterion for determining this It may be a question of which sense of circulation gives the smaller dissipation of energy The analogy with Bénard's cells would require that the instability should extend through a layer the depth of which is determined by the physical constants, and is relatively shallow

It is possible also that some of the phenomena associated with thunderstorms can be explained in the same way Thunderstorms may be ascribed to vertical instability in the atmosphere, and the violence of thunderstorms would appear to indicate that a high degree of instability is built up before the breakdown occurs It is suggested that this is brought about by the stabilising effect of transfer of heat and viscosity, up to a critical stage, beyond which the arrangement is unstable, and breaks down with violence The analogy with Bénard's experiments is borne out by the frequent occurrence of a network of thunderstorms, which break out at the same time over a wide area Further, the ratio of horizontal to the vertical dimensions of thunderstorms is of the order suggested by the analogy with Bénard's cells

The form in which the instability breaks down near the ground, in the frequent superadiabatic lapse-rates which occur in the bottom layer of the atmosphere, affords an interesting problem, but as this problem is under investigation by others, it can only be referred to in passing Certain details of the records shown by the microbarograph can probably be explained in this manner

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Blood Pressure in Early Life.

IN a friendly review of my work on "Blood Pressure in Early Life" appearing in NATURE of January 10, criticism is directed to a deduction I made on pp 50-51 regarding the average expenditure of work by the heart in maintaining the circulation at different ages. Though this was only one of the sixteen main conclusions, and I admitted it to be the most doubtful of them, I should be glad to have the opportunity of replying to the points which are raised

I intended to make it clear that my argument regarding the proportionality between cardiac energy expended per minute and the product of pulse pressure and pulse rate was limited to a comparison between *mean values* for large groups of individuals of the same age, that there is any basis for thinking that such a relation necessarily holds good in comparing one individual with another I did not suggest The initial assumption was that energy expended by the heart was approximately proportional to volume of systole × pulse pressure × pulse rate I then stated (p 50) that "the value of V (volume of systole) cannot be measured readily and it is no doubt variable within certain limits in individuals of the same age, weight, and height, but we may perhaps make two assumptions (1) that during the period of growth the mean values of V for large groups of growing individuals are directly proportional to the mean body weights of these groups, (2) that the average value of V remains fairly constant in adults up to middle life" From assumption (2) plus the original one it followed that "in comparing large groups of young adults aged 20 and upwards of the same sex, the *mean* product of pulse rate and pulse pressure is directly proportional to the *mean* work done by the heart per minute" This deduction is not merely one of my original assumptions, as the review states, since we have got rid of V from the original equation. From assumption (1) plus the original one I further deduced that the "mean expenditure of cardiac energy per minute for a group of individuals of a given age" is proportional to mean weight at that age × mean value of product of pulse pressure and pulse rate for that age The word "mean" was monotonously repeated and also emphasised by italics because the application of the same reasoning to a comparison between individuals would be unsound, since there is every reason to suppose that V is as variable amongst individuals of a given age as any other anthropometric factor, and probably more variable than most factors

Without disparaging experiments on the isolated mammalian heart, I should have grave doubts whether the complex conditions met with in the human subject could be reproduced with sufficient certainty to pronounce for or against the truth of any of these

assumptions or deductions Even granting that they could, if the pulse-pressure × pulse-rate product is made to vary in the same heart by artificial means, other factors may come into play, and I know no evidence to suggest that the equation would hold good under any but normal conditions, on the other hand, if only a few different hearts are compared under constant conditions, we are not dealing with mean values but with individuals

The real point at issue is whether the pulse pressure is a factor at all in the actual work done I cannot agree to the contention that the energy expended "is in no direct manner connected with the pulse pressure" It seems reasonable, however, that the mean pressure should also be taken into account In the somewhat analogous problem of a pump working against gravity, the work done per "beat," ignoring the kinetic factor, is proportional to cross-section of pipe × mean height of fluid × change in level of fluid, and if the fluid level be restored to its original height by a siphon before the next beat, a further multiplication by number of beats per minute gives an expression for energy output per minute Applying the analogy to the circulation, the mean cross-section of the arterial system at ages during growth may be assumed to vary as the mean cross-section of the body, or as the mean square of a linear measurement such as the stature at those ages, and the other factors in the expression are represented by mean blood pressure, pulse pressure, and pulse rate The values of the fourfold product at ages from 10 to 21 (using smoothed figures from the curves and dividing the results throughout by 10^6) are :—

10. 4466.	13. 6863.	16 11,264	19 10,992.
11. 5075.	14. 8155	17. 11,765	20 10,670
12. 5861.	15. 9927.	18. 11,465	21. 10,490.

This method leads therefore to precisely the same conclusion as before, namely, that "when the age of 16 has been reached the average heart is performing as much or more gross work per minute than in adult life in spite of the fact that it has presumably not attained full size", the maximum, as before, occurs about 17. PERCY STOCKS.

Dept. of Applied Statistics,
University College,
London, January 26.

I REALISE that Dr. Stocks, when making his initial assumption that the energy expended by the heart per minute was proportional to the product of the volume of blood expelled at each systole, the number of beats per minute and the pulse pressure, intended this assumption to apply merely to the relationship of the mean values of these factors in large groups of individuals I do not see, however, how this makes the assumption any the more justifiable The real point at issue is, as Dr Stocks himself mentions in his letter, whether the pulse pressure is a factor in the expression for work done.

In the "somewhat analogous problem of a pump working against gravity," the work done per beat is admittedly proportional to the product of the capacity and intensity factors, namely, cross-section of pipe × change in level of fluid and the mean height of the fluid respectively In the case of the heart the pulse pressure, if it is of any significance as an indication of energy expenditure, must be shown to be related to either the capacity or the intensity factor of this energy There seems to be no justification for including it in the former, especially since the mean output per beat for large groups of growing individuals is assumed to vary directly as the mean body weight Similarly, to include it in the latter seems equally unjustifiable, seeing that the intensity factor in cardiac work, as was pointed out in the review, is the mean blood pressure during the ejection phase of systole. Accurately to determine this mean it would, of course, be necessary to know the average time course and to take the integral of this This is, however, impossible in man, but the true figure may be approximated to sufficiently accurately if we take in its stead the mean between systolic and diastolic pressures

If this is done and the product of body weight and mean pressure between the systolic and diastolic levels determined for different age groups, it will be clear that the figures do *not* show any maximum at the age of 16 or 17 years One may conclude from this that at no period during adolescence is the average heart performing as much work per beat, or taking pulse rate into consideration, per minute, as in adult life THE REVIEWER.

Diamagnetic Orientation.

GLASER, in a recent paper (*Ann der Phys*, 21, 459, 1924), of which a short account was given in NATURE, January 10, p 64, has shown that the apparent molecular diamagnetic susceptibilities of H_2, N_2 and CO_2 are three times as great at low as at ordinary pressures. He attributes this to orientation, the tendency to orientate being counteracted at higher pressures by the effects of molecular collisions. He is unable, however, to account for the factor 3 in this way.

If the molecules tend to orientate with their axes along the direction of the field, this factor may be easily accounted for Owing to the relatively large mass of the nuclei, it is only about the line joining them that the molecule will acquire an appreciable magnetic moment under the influence of the field, the effective field being the component of the external field along the direction of this axis. The ratio of the apparent susceptibility for fully orientated molecules to that for molecules orientated at random will then be $1/\int_0^{\pi/2} \cos^2\theta \sin\theta d\theta = 3$.

The importance of extending the measurements to monatomic gases need scarcely be emphasised.

EDMUND C. STONER.

Department of Physics,
The University, Leeds,
January 21

Animal Mechanism.

WHEN a swan is rushing to the attack of an adversary, the head is lowered and the neck is protended almost horizontally I had always associated this posture with mere anger, but, during the excessive Thames floods of last December, when swans could often be seen striving against the stream, sometimes, so far as could be judged, in the apathetic state of desperate exhaustion, the same pronation of the neck was frequently evident

The explanation seems to be dynamical, for the reactions on the feet of the bird would, without the counterpoising action of the neck, tend to rotate the body about a horizontal axis, head backwards Air resistance also plays a part

It is of interest to note that the racing motor-cyclist, in his unreasoned but experimentally justified preference for forward weight, has found a solution akin to that of the swan Many sprinters, especially when starting, use the same principle

H. S ROWELL,
Director of Research,
Research Association of British
Motor and Allied Manufacturers,
15 Bolton Road, W.4,
February 11

The Skull and Ancestry of Robert the Bruce.

WE know men better when we have seen them in the flesh, even if we have no speech with them A knowledge of their homes fills out our mental picture of them Darwin becomes more alive to us when we have been round his home at Down There have always been a few who cherish the belief that the skulls of our famous dead, the homes in which their brains lived, and the bony screens on which their living visages were spread, can speak with a precision and with an intimacy beyond even the efforts of the best artist. For the human skull has a language of its own, one which is hard to decipher After centuries of endeavour we can construe only its simpler hieroglyphics, yet we do continue to improve, and our progress justifies the belief that the day will arrive when a rational craniology will become the handmaid of biography This is the belief of Prof. Karl Pearson; in a monograph he has published on "the skull of Robert the Bruce, King of Scotland," he has written thus:

"I can imagine a time, when public opinion being sufficiently educated, it shall be looked upon not as a desecration but as a solemn duty, reverently to exhume and study the crania of the departed great with a view of adequately correcting portraiture, or of supplying it where it is deficient." [1]

As all good Scotsmen know, Robert the Bruce was born in 1274 and died in 1329, aged fifty-five. He was buried in Dunfermline Abbey, and there his bones lay until 1819, when they were uncovered during certain rebuilding operations. The traditional and circumstantial evidence leave little if any doubt that the skull and skeleton found were those of the great king. Accurate moulds of the skull were taken before it was reburied; a cast taken from this mould is in the Museum of the Royal College of Surgeons, England, where it is placed cheek by jowl with a King Robert of a later date—Robert Burns. Another and, in Prof Pearson's estimation, a better cast of Bruce's skull is preserved in the Museum of Edinburgh University, and it is this which he has made the subject of his monograph.

The writer of this notice has also made a study of the cranial cast of the Bruce,[2] and although his methods differ from those employed by Prof. Pearson, yet the main conclusions reached by each are in agreement The skull of the Bruce has characters of the most outstanding kind, chief of which are the rugged robustness of its face, the outstanding ridges over the eyes, the enormous width across the face from jowl to jowl, and the strength of jaws. He was bull-necked, as is plainly indicated by the extent and strength of the bony platform on the base of the skull whereto the neck is fixed Such an extensive platform signifies large and strong muscles in the neck, and such muscles in the neck require equally strong muscles of the spine and body. There is in the Museum of the Royal College of Surgeons a rib of King Robert, it is the 9th of the left side It had been broken in some mischance which had befallen the King, but had healed well and soundly.[3] The rib shows him to have been a big-chested man, one we should expect to have a relatively long body, and yet his thigh and leg bones were not long Prof. Pearson finds that their dimensions answer to those of a man about 5 ft 6 in in height. Bruce may well have been one of those men who seem tall when seated and yet of medium height when standing up, in which case we may add two or three inches to the estimate given by Prof. Pearson.

Bruce's skull is long and particularly wide—its width being about 78 per cent of its length His brain was large, Prof Pearson estimates his cranial capacity to have been 1595 c c—about 8 per cent above that of the average Briton Neither Prof Pearson nor the writer attach importance to the size of the brain, what has impressed both are the massiveness and strength of the cranium itself "Bruce's skull," writes Prof. Pearson, "suggests a man of most exceptional muscularity and strength, with a bull-neck and ardent passions" The writer has expressed his conclusions thus. "It would be the strength and configuration of the face rather than the size of the brain that would weigh with most students if they sought to hazard a guess as to the nature of the man of whom such a skull had formed part. We should suppose him to have been a forceful leader of men" [4] Herein Prof. Pearson and the writer are drawing their inferences not from any systematised body of knowledge but from the everyday observation open to all—that men with such cranial characters as we find in Bruce are swayed by the strong appetites and passions of the natural man. If tradition speaks true, Bruce was no exception to this widely held belief

Of what race was Bruce? Prof Pearson, following tradition, looks upon him as a hybrid between Norseman and Celt, and adds: "He was able by Celtic imagination, with a certain dash of slimness, to win the Scottish nation to his side, and by aid of Nordic physique and persistency to be triumphant over his enemies" This statement might well be a quotation from the speech of a political historian; it certainly is not the language of craniology. The term Celt has been applied to diverse breeds of men, but Bruce's cranial type is not prevalent in any of them. Nor is it a type which is found in Saxon or Danish graveyards, although samples do occur in the Frankish burials of the north and west of France Bruce's skull has more in common with what has been named by British anthropologists in recent years the "beaker" type than with any other known to the writer. Men with this type of skull began to take up their habitation along the eastern coasts of Britain early in the second millennium B C. They are known as "beaker" men because of the peculiar kind of earthenware vessel buried with them. Before they appeared in Britain they had penetrated to Baltic lands and spread southwards into France. Bruce's ancestry may have acquired the "beaker" blood in Baltic lands, in France or in Cleveland, where the type still persists.[5]

It is this persistence of type which lends interest to the comparison of ancient and modern skulls. Those familiar with the skulls of beaker men obtained from

[1] *Biometrika*, December 1924, vol. xvi., Pts III-IV, p 260.

[2] Phrenological Studies of the Skull and Brain cast of Sir Thomas Browne of Norwich, Henderson Trust Lectures, No 111 Edinburgh, 1924

[3] This rib was taken from the open tomb in 1819 by Dr William Mackenzie, whose life appears in the "Dictionary of National Biography" He died in 1868 He was both accurate and learned, and was regarded in his day as the leading ophthalmic surgeon in Scotland

[4] *Loc cit.*

[5] The spread of the "beaker" type has been discussed in an address given by the writer on "The Bronze-Age Invaders of Britain," Journ. Roy. Anthrop Institut, 1915, vol. 45, p 12.

the round barrows of Wilts have no difficulty in recognising their counterparts among their companions of to-day. After a hundred matings or more in a land where long heads have vastly outnumbered the round heads, this beaker type still persists Darwin was almost a representative "beaker" man, wherever leading British men are met together there is certain to be an undue proportion of round-heads In more senses than one the beaker type is dominant

The first article [6] in the number of *Biometrika* which contains Prof. Pearson's study of the Bruce's skull, helps us to understand such a persistance of a human type. This article by Dr Ernest Warren deals not with human beings but with foxgloves, but we can legitimately transfer his results from the one to the other, for we have every reason to believe that heredity works in the human stirp just as it does on that of the foxglove. Dr. Warren observed that parental characters may form a perfect blend in the progeny, or there may be no blending—the characters of one parent dominating or ousting the corresponding character of the other parent To use his own words "Mendelian inheritance and perfect blending inheritance may be regarded as the two end terms of a series, and all grades of partial blending or partial segregation lie between." The same must be true of human matings; at least such a supposition accounts for the facts which are brought daily to the notice of anthropologists The man of the Magdalenian period, unearthed recently near Bonn, had just such a development of cheek and jaw as reappeared in Robert Bruce some ten or eleven thousand years later

In his search for authentic portraiture of the Scottish king, Prof. Pearson consulted the image on the Scottish coins of Bruce's reign He found that the stamped image was in no sense a portrait "As for the eye," writes Prof Pearson, "it is remote from the orbit, but this is an artistic (?) convention even in the case of modern designers' profile portraits On a penny postage stamp or a half-crown of his present Majesty the King, the distance from nasion to outer border of orbit is about one-third of the distance from the nasion to auricular passage, whereas in the profile of a skull it is nearer one-fifth" Herein Prof Pearson does the designer of His Majesty's image a certain degree of injustice The extent to which the nasion (or root of the nose) projects in front of the side wall of the orbit, when a skull is viewed in true profile, is a guide to race, and hence the writer has given this facial character some attention In Bruce's skull the nasion lies 97 mm. in advance of the mid-point of the ear passages, the sides of his orbits 72 mm., the difference between these measurements—the *naso-orbital depth*—is 25 mm, this being 25·8 per cent. or rather more than a fourth of the auriculo-nasal projection.

Herein King Robert was typically British, for in ten male British skulls taken at random, the mean of the corresponding measurements were 95 8 mm and 71 2 mm—the naso-orbital depth being 24 6 mm—or 25 7 per cent of the naso-auricular line To obtain a face in which the naso-orbital depth falls to Prof Pearson's standard, a fifth or 20 per cent, one has to go to skulls of Chinamen Ten male skulls of this race, taken at random, gave these measurements, 92 8 mm. and 74·4 mm.—the naso-orbital depth being 18 4 mm.—almost exactly one-fifth of the naso-auricular projection. In the image on the half-crown which lies before the writer, the nasion is 8 mm distant from the ear passage and the margin of the orbit 5 mm The naso-orbital depth given by the designer of the coin is 38 5 per cent of the naso-auricular distance—certainly 12 per cent more than it should be were His Majesty's head represented in true profile But then it is not a true profile, the artist has purposely turned the head far enough towards him to make the opposite (right) eye-brow visible, and his drawing gives His Majesty's features in their just position It is otherwise with the photographs which Prof Pearson has reproduced of the Bruce's skull, the camera, as cameras always do, has given a distorted view of the skull, reducing Bruce's naso-orbital distance to one-fifth of the naso-auricular line, thereby committing an error of nearly 6 per cent The photograph of a skull cannot take the place of an accurate drawing, in the writer's opinion, photographs are useless as craniological documents

It is a curious circumstance that although Scotland has produced an undue share of anatomists, she has had to depend, until lately, on Englishmen for a knowledge of her own people It was Dr John Beddoe who made the first anthropological survey of Scotland, it was Sir William Turner who first made a study of the craniology of its inhabitants past and present. Now Prof Pearson has given the first adequate account of the skull of their great king To those who have studied Prof Pearson's monograph it must seem particularly ungracious on the part of a Scotsman to allow such carping criticism as he has just made above to escape from his pen, for in his final paragraph Prof Pearson makes an appeal which must dissipate the "Scots-wha-hae-ism" of the most stony-hearted native of North Britain There the great biometrician writes thus "Even the aged dream dreams, and I should like to see a national monument to Bruce at Westminster, an effigy based on the skull as only a great sculptor could conceive it But it should be the gift of Englishmen only to the united nations . . The union of our nations needs no artificial cement, but it would be a graceful act for Englishmen to present Scotsmen with what at present they lack, a real characterisation—which I hold is still feasible—of one of their great heroes"

Far be it from the writer to damp in the slightest degree so gracious a proposal, and yet there may be some who will think that Prof Pearson, while he gives with one hand, does take somewhat away with the other. He suspects that Robert Bruce may have been the subject of syphilis—a suspicion which never crossed the minds of the very able medical men who examined the king's skull and bones when they were disinterred. The writer has searched the pre-medieval graves of England and Scotland for traces of syphilis and found none, and those who know our medical records believe that Robert Bruce had been asleep in Dunfermline Abbey for two centuries before this fell disease appeared in Britain

A KEITH.

[6] "On an Interspecific Hybrid of Digitalis," by Dr Ernest Warren

Biographical Byways.[1]

By SIR ARTHUR SCHUSTER, F R S

9 GEORGE GABRIEL STOKES (1819–1903)

THE collection of Sir George Stokes's published papers, together with the "Memoirs" and scientific correspondence edited by Sir Joseph Larmor, contain such an excellent account of Stokes's activities and personality that nothing remains but to confirm, illustrate, or emphasise what is already on record

Stokes was elected as one of the secretaries of the Royal Society six years after the constitution of the Society had been altered by the limitation of the number of fellows elected annually It was a critical time, and though there was no sudden change in the policy of the Society, new traditions had to be established The range of his knowledge, the width of his sympathies, and his almost infallible judgment peculiarly fitted Stokes for a position which offered so many opportunities of advising striving and sometimes stumbling men, and guiding their work into profitable directions

My own experience was similar to that of many others In the account I gave of Osborne Reynolds, I mentioned a certain experiment which I had performed demonstrating that the motion of the radiometer was due to internal stresses The paper describing the experiment was sent to the Royal Society and I received, in due course, a communication from Stokes forwarding some suggestions made by the referee I complied to the best of my ability, and in informing me that the paper had been ordered to be printed, Stokes added, that in his judgment the paper was not improved by the changes I had made in deference to the referee He further made a significant remark, which is worth remembering by those charged with the difficult and responsible task of reporting on papers It was to the effect that, in his opinion, it was best to allow the authors of papers to express what they had to say in their own words, even when improvements might be effected When I quoted this remark to Maxwell a year or two later he told me that he had been the referee, but I believe he agreed with the general principle. The suggestions which Stokes himself so frequently made to the authors dealt with matters of principle rather than with the manner of expression

I have in my possession five letters written by Stokes during March and April 1885, and dealing with a subject on which there has been, and still is, a good deal of misapprehension The question at issue is referred to in the correspondence of July and August 1899, reprinted in the "Memoirs," vol ii. pp 123-125 Stokes writes to Rayleigh in July 1899

"Some years ago Thomson or Kelvin (I forget which he was then), you, and I were together at the Royal Society, and Kelvin asked me what I thought of a result you had arrived at that the appearance of bands of interference in a spectrum did not prove regularity in the light, but only high definition in the spectroscope If this meant what it appeared to mean I utterly disbelieved it, it seemed so manifestly untrue"

In his reply Rayleigh writes

"I am afraid that I shall stand condemned, for I do think that 'a vast succession of independent impulses following one another casually' would show interference, of course with the aid of a spectroscope."

My correspondence with Stokes, which took place fourteen years earlier, deals with a design for an experimental arrangement suggested by him, which it was hoped would give "a large retardation of one of two interfering streams of light relatively to the other, and yet having the bands in one part of the spectrum so broad as to be easily observed, unless that should be prevented by the irregularity of the vibrations of the incident light"

The method depended on introducing into one of the interfering streams of light a dispersive medium, having a length adjusted so as to make the difference in path measured in wave-lengths in the two streams equal to each other within a certain range of the spectrum, in a manner suggested by that adopted in achromatising lenses I do not now remember what ultimately prevented the investigation from being carried out When I examined the question some years later (*Phil Mag*, June 1894) in the light of Gouy's and Rayleigh's discussion of the subject, I was fully converted to their opinion, but I do not believe that Stokes was ever convinced In my judgment, the effect anticipated by Stokes in his arrangement would have been observed with sufficiently great resolving power, but it would have taught us nothing on the regularity of the incident light, because the observed regularity would have been introduced by the resolving power

During my stay at Cambridge, many tales were current with regard to Stokes's taciturnity My own experience is in the other direction On several occasions I sat next to him at College dinners, but never had any difficulty in finding a subject of conversation on which he would enter with pleasure and sometimes with animation He had several interesting tales of his intercourse with Brewster, who never could be made to abandon the corpuscular theory of light. Even when Foucault had proved that light was transmitted more slowly through water than through air, Brewster refused to give in

Stokes was an old man when he died, but his scientific outlook always remained young New ideas pleased him, and he delighted in hearing of experiments that did not fit in with any of the accepted theories His peculiar form of wit is referred to in the "Memoirs," and I recollect one instance of it At an excursion, during the celebration of the Kelvin Jubilee at Glasgow, Rontgen's discovery of the X-rays was referred to in the presence of some of the foreign delegates. Quincke stood up for the claims of Lenard, whose work according to him had to some extent anticipated Rontgen Stokes replied "Lenard may have had the rays in his brain but Rontgen got them into other people's bones" Whenever I afterwards met Quincke he never failed to repeat this remark with enjoyment

The strong religious opinions held by Stokes are well known I am told, on trustworthy authority, that he voted against the extension of university privileges to

[1] Continued from p 271

non-conformists, but this should not be taken as an indication of any want of religious tolerance. His whole life would contradict such interpretation. He could only have acted under a strong sense of personal responsibility.

In the sketch of her father's life, Mrs Humphrey writes (vol. i. p. 6): "As a little boy he was subject to violent though transient fits of rage . . ." I was interested in this remark, but not altogether surprised, because I once saw an almost ferocious look on Stokes's face It was at a meeting of the British Association when he thought that some one was taking a liberty with him. But this look was quickly replaced by his usual smile, as he turned round and saw that it was only Lord Kelvin patting him on the back

Stokes lived a long and useful life, alert and vigorous almost to the end There are few men who have secured the esteem and love of their fellow workers to the same extent I shall always remember Lord Kelvin, as he stood at the open grave, almost overcome by his emotion, saying in a low voice "Stokes is gone and I shall never return to Cambridge again."

The Vision of Nocturnal Animals.

By Prof. S. RUSS.

IN some experiments, conducted with Dr. J. C Mottram during the War, upon the best conditions for night vision, the question arose as to what part the transparency of the media of the eye plays in determining acuity of vision in dim lights It is known that individuals vary between wide limits in their night vision, some appearing almost blind in a night of average darkness. Further, it is known that many wild animals have very little difficulty in making their way about or in finding their prey in dim lights, though the sense of smell may not, in the latter category, be neglected. In the night owls this sense is, I understand, excluded, for they find their prey solely by the sense of sight.

Experiments of a direct character were made upon the enucleated eye by cutting away a small portion of the retina at the back of the eye and cementing over this aperture a thin quartz plate It was generally possible to do this without loss of fluid or deformation of the eye; this was now mounted in front of the slit of a quartz spectrometer, and the extent to which the radiation from an arc (cadmium or tungsten) was transmitted through the eye was measured photographically It was soon evident that all of the eyes tested exerted, as was expected, a considerable degree of absorption for the major portion of ultra-violet radiation from the arc, but that what appear to be significant differences were shown by the eyes of different animals.

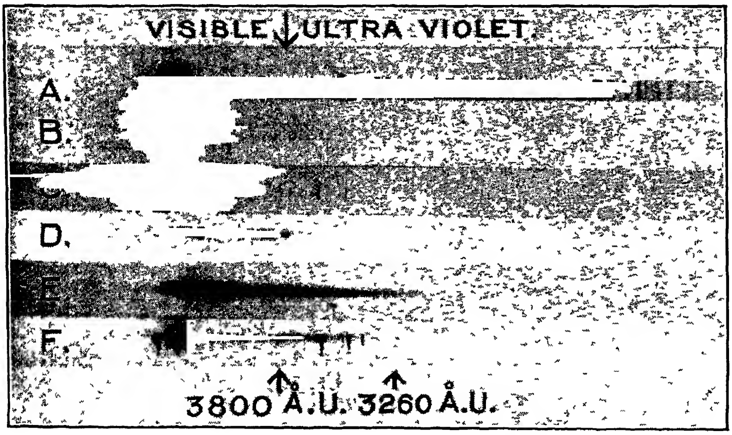

FIG 1

In Fig. 1 are collected the results of a number of such experiments: The strip A is a photograph of the ordinary arc spectrum of cadmium, the remaining photographs are with the experimentally mounted eyes interposed between the arc and the slit of the spectrometer. B shows the transmission by a human eye; and the other strips transmission by eyes of a lioness, C, a bear, D, great eagle owl, E; and a tiger, F. Others tested were the eye of an ox, which showed about the same degree of absorption as the human eye, and a cat, which closely resembled that of the tiger. Three human eyes were tested, and they showed no important differences from one another. How far the different degrees of transparency shown are dependent upon post-mortem changes, it is scarcely possible to say; it may be mentioned, however, that the human specimens were probably fresher than any of the others, yet they showed the greatest opacity to the short wave-lengths.

On testing in the same way the various parts of the eye, it was found that the lens was a more absorptive element than the cornea, the humors of the eye being more transparent. It is interesting to note that, if a person is examined in pure ultra-violet radiation, the lens is seen to fluoresce vividly, the cornea less so. The sensation when one is subject to this invisible radiation is that of the eye being filled with a pale blue light.

At a meeting of the Ophthalmological Section of the Royal Society of Medicine on January 9, these observations were discussed in their relation to night vision. If it be a fact that the eye of the nocturnal animal or bird is transparent to a certain range of ultra-violet radiation, and that this reaches the retina in an appreciable quantity, it may be that it is a valuable aid to vision In the discussion, Sir John Parsons questioned the value of such a radiation to an eye chromatically adjusted to the visible region, but little is known about the range of radiation for which the optical parts of these eyes are most efficiently adapted Prof. Hobday mentioned that, during the War, Australian horses were used in Palestine for night work, because they did not suffer from night-blindness

Obituary.

DR HORACE T BROWN, F.R S.

A PENALTY of living is to outlast one's friends, especially the oldest, earliest and most esteemed Not long ago, I engaged in the impossible task of painting a picture of James Dewar, whom I first met in 1875 Now, the call comes for a portrait of Horace Brown, my fellow-student in 1865, the last of the great Burtonian chemical quartette—Peter Griess, Cornelius O'Sullivan and the brothers Brown My palette must be cleaned and charged anew with very different colours—the lights and shades to be depicted are of another order No two persons stand in greater contrast. The one a man of fire and fury, a volcano of surging impetuosity, astounding in his individuality —the other, one of Nature's gentlest men, though adamant in purpose, gifted with a placid personality and a refined urbanity and charm of manner which won for him a large circle of devoted friends, scarce a detractor. Both were philosophers but the one was a consummate artist and actor, the other a naturalist from birth and, though not born to blush unseen, sparing in criticism, reticent and retiring, a conformist in most matters

Horace Brown was congenitally fitted to walk the paths of chemistry on vital territory. Few are, strange to say the mentality of most chemists being definitely mechanical and physical; only the elect seem to be able to sit quietly on "the dear old Nurse's knee." He was pre-eminently happy when wandering in her company, whether in the open field or in the laboratory—unveiling the activities of micro-organisms and separating the sheep from the goats, wet-nursing the barley-embryo or tracking the nimble molecules of carbon dioxide, through the stomatal openings, on their way to destruction and burial as sugar and starch in the vegetable cell. The secret of his success lay, I think, in his great powers of application and concentration and the faculty he had of getting up the subject he wished to explore, by prolonged preparatory study

I have told the story of the family in my notice of Adrian Brown, his half-brother. He was a posthumous child, born July 20, 1848 His father began life as a farmer, so he came from the soil, as he once said to me. His mother's remarriage, to Edwin Brown, brought him under the care of a man of high attainments and wide culture, an ardent naturalist—so he grew up under most favourable conditions. His scientific leanings were such that he began to study the stars seriously in his out-of-school hours when only twelve years old. A year or so later, electricity caught his fancy Following a book which he found in his stepfather's library, he made a frictional machine and a Leyden jar, which gave him great joy; he even went so far, that he constructed a galvanic battery, with which he studied electrotyping The fortunate gift of a microscope, when he was twelve or thirteen, made him an ardent and systematic microscopist—thus qualifying him to use the instrument with facility and success in his later technical career When about fourteen, the discovery of a retort and pneumatic trough among his stepfather's possessions led to his preparing oxygen This he regarded as the turning point in his career. He then came to the conclusion that he must be a chemist: in early life he had aspired to be a railway signalman. Beginning his experimental work in the kitchen, he soon came to regard a whiff of sulphuretted hydrogen as more precious than the odour of violets—but not so the cook: so he migrated to a store-room He left school at sixteen and a half By then, in his attic workshop, quite unaided, he had mastered simple qualitative analysis, with the help of Fresenius He also did a little quantitative work, under guidance of the great Peter Griess, in the laboratory at Allsopp's brewery.

Contrast Brown's training with that of the public schoolboy of to-day—who is not allowed to do anything of his own accord but constantly drilled into dull habits of conformity and helpless thoughtlessness: moreover, there are no waste places in the Flat-land of to-day. Where then is the "Dear Old Thing" to find followers in our times? Even country schoolboys are forced to play games and be examined by literary Dryasdusts, instead of willingly wooing and examining her. Little wonder that we complain that we no longer have leaders The made-blind will never lead.

Horace Brown left school at the end of 1864, in the Sixth. In April 1865 he passed from Burton-on-Trent to the Royal College of Chemistry, Oxford St, London, to become a student first under Hofmann, then under Frankland He left at the close of the year, however, to enter the brewery of Worthington and Co. at Burton, as an apprentice, the youngest of three assistant brewers. He was to receive 50*l* the first year and only 90*l*. in the fifth The young chemist to-day grumbles at 250*l*-300*l* There was no brewing chemistry in those days, even a prejudice against it; the brewer, in fact, was an empiric Brown could only work in his scanty leisure hours, *sub rosa, privatim*, in a garden laboratory, which his stepfather had built for him, in 1866. He here began some research work, at Griess's suggestion. It took him nearly two years to persuade the authorities to purchase a balance and apparatus with which he might determine the original gravities of beers but this was installed in the office Then came an opportunity which he at once took In those days, liquor (water) was the dominant spirit in beer —everything that happened—every bad thing—was set down to water. So when Frankland and I, early in 1868, made known our method of determining organic matter in water, he readily obtained leave to spend the slack summer period in London, in Frankland's private laboratory Having learnt to use the special appliances our method involved; among others, the Sprengel pump—which we were the first, after Graham, to adapt to practical purposes—and its tricks, he returned to the brewery and was allowed to fit up a laboratory. What that laboratory has been worth indirectly to the industry, it would be difficult to say—certainly a good round number of millions

Brown forthwith made a survey of the Burton water supply, including the river. He thus became an authority on the subject and was instrumental in securing the abolition of the parish pumps, veritable cesspools—although only of age. As the ills that beer was heir to could not be traced to the water, he now devoted himself to the microscopic study of yeasts and soon became aware of their "mixed" character At this period,

though not until 1870, Pasteur's great work, perhaps his greatest, "Études sur le vin" (1866), came into his possession and the already loosened scales soon fell from his eyes. It became clear that the souring of stock ales was comparable with the souring of wines. When Pasteur's "Études sur la bière" was published in 1876, he had little to learn from its microscopy. Meanwhile, he had perfected a method of "forcing" beers. This involved the use of a rectangular copper box or tray containing water, kept at a regulated temperature, considerably above the average atmospheric (80°-85° F.). Samples of the beers, in small closed flasks, provided with a side tube dipping into a mercury seal, were kept on the tray during several days; the deposit was then examined with the microscope and the extent determined to which pirate organisms had developed. It was then easy to forecast the behaviour of the beers in store and so determine the order in which they should be put on the market. The monetary value of the method to the industry was very great.

Largely owing to Horace Brown's work and influence, brewers quickly learnt to appreciate the value of Pasteur's teachings and soon began to put their houses in order. The progress of bacteriology in Great Britain, especially its application to water supply, was also hastened. Horace Brown, in fact, played the same part in brewing, in leading brewers to clean up their plant and adopt aseptic methods, that Lister played in surgery—he was even in advance of Lister in appreciation of Pasteur, though a much younger man. He became manager of the whole of the manufacturing department of Worthington's in 1873, at the age of twenty-five, and occupied this responsible post until 1889, when he became one of two managing directors on the incorporation of the firm as a limited liability company. He resigned in 1893 and left Burton for London, after which time his work was done privately.

What more Horace Brown accomplished before and after he left the brewery cannot usefully be told here. Suffice it to say that he was recipient in succession of the Chemical Society's Longstaff Medal, of a Royal Medal and eventually of the Copley Medal of the Royal Society—only given in recognition of outstanding service to science. His work is noteworthy on account of its thoroughness, the elegance of his methods and the philosophical manner in which he discussed the fundamental problems which engaged his attention. He was one of the few chemists who have done pioneering work of real importance in the biological field, notably in botany.

In the interval since Brown and I became friends, science is certainly risen: its power is certainly proven. Still, it is in some measure fallen—the public effect is not that anticipated by Huxley, Tyndall and others. The clerics openly scoff at our failure and do not sense our one supreme object—the discovery of truth, how infinitely superior belief through such discovery must be to all belief through mere faith, how perfect a religion must eventually be framed through it.

The lesson of Horace Brown's education and life is to be pondered by those who realise how complete a failure is the teaching of "science" in our schools and even in our universities, as a means of inculcating in the community an appreciation of its method and majesty and its usefulness.

Henry E. Armstrong.

Dr. E. Klein, F.R.S.

With the death of Dr. E. Klein at Hove on February 9, one passed away who had played an important part in English medical science for more than half a century. It is not an easy thing to give a complete account of him or to estimate accurately the value of his work. He had been with us so long that but few of his early contemporaries survive, while the younger workers from whose lives the War subtracted years knew him merely as a name, and had probably never seen him. Indeed, he was a somewhat elusive personality to all of us, as he kept a good deal to himself. The present writer knew him as a fellow-worker in the same branch of study, and had also dealings with him of a scientific kind. Much of what has been written of him since his death will be found to be incomplete and inaccurate. Our claims to write of him rest on information derived from two friends who knew him intimately half a century ago, on a personal acquaintance with him for half this time, and on an intimate study of almost all his works, a study with which we have refreshed our memory since his death.

Emanuel Klein (the name Edward was assumed only after his arrival in England) was born in 1844 at Osijek (Essek), the chief town of Slavonia, situated near the junction of the Drave and Danube. His father was a tanner of Russian leather. Nothing is known of his early years, but he related himself that he was in London when about eighteen—possibly in the capacity of a tutor. His medical education was in Vienna, and after graduation he carried out original investigations, chiefly embryological, in the laboratory of Salomon Stricker (1834–98), at that time professor of general and experimental pathology in the University. In 1871–73 Stricker was publishing his great "Handbuch der Lehre von den Geweben des Menschen und der Tiere," and for this work Klein wrote the articles on the thymus gland, the external generative organs, the serous membranes, and, in collaboration with Verson, the article on the histology of the intestinal canal, and, with Stricker and Stieda, on the conjunctiva and sclerotic. Klein's original work was, however, mainly embryological in connexion with the development of the vascular system of the chick. Stricker's Handbuch was translated into English by Henry Power for the New Sydenham Society, and Klein came into contact with several English workers.

When the Brown Institution was started in 1871–2 by the purchase of two houses in Wandsworth Road, Burdon-Sanderson applied to Stricker for a suitable resident assistant director, and Klein being recommended, he came to England and lived in one of the houses (now turned into shops). He was well received, and proved a *persona grata* from the start. In those days a number of the more ardent young consultants, such as J. F. Payne, Cavafy, and Pye-Smith, used to forgather at his house to discuss science, and incidentally to play whist. Klein had also some private pupils, among whom were Francis Darwin, Frederick Treves, Jeremiah MacCarthy, and James Adams. In 1873 he was appointed to give a course of lectures on histology in Morrant Baker's physiological course at St. Bartholomew's Hospital, and thus began his long association with this ancient and noble institution, first

as teacher of histology and later of advanced bacteriology Here also was done most of his work for the Medical Department of the Local Government Board after he left the Brown Institution

Almost all Klein's early work was on histology, a branch in which he was and is an acknowledged authority In 1873 he wrote the section on histology for the "Handbook for the Physiological Laboratory," edited by Burdon-Sanderson, Foster, Brunton, and Klein In the same year he published an authoritative work, in two parts, entitled "Anatomy of the Lymphatic System" These volumes were profusely illustrated with beautiful drawings by Klein from his own preparations, and he exploited with great success the method of silver impregnation which was introduced into histological technique by von Recklinghausen (1860) In 1875 Klein was elected a fellow of the Royal Society His reputation as a histologist was greatly increased by the publication, in conjunction with the orthopædic surgeon Eldred Noble Smith (1847–1906), of the classical "Atlas of Histology" (1880). The forty-eight magnificent plates in this work were drawn by Noble Smith from Klein's preparations, and some of the illustrations have been copied into almost every English book on anatomy and physiology down to the present time Klein also published a standard "Elements of Histology," which ran through many editions and was translated into several foreign languages

We have dealt in some detail on Klein's activities in histology because we feel convinced that, although this occupied chiefly his earlier years, it is the work by which he will be best and longest remembered. He was brought to England not as a normal histologist, but to engage in the histological problems connected with disease, and he drifted into experimental pathology and bacteriology, as we think, *malgré lui* He lived and worked untiringly throughout the whole of the classical period of bacteriological science from 1876 to 1900, and it is greatly to be regretted that his name cannot be placed alongside those of Pasteur, Lister, Koch, Loeffler, Roux, Pfeiffer, Weichselbaum, Kitasato, Behring, and Ehrlich, as the discoverer of any really important ætiological agent of disease Indeed, it may sound like a paradox, but on more than one occasion he failed at first to confirm work which has become part of established bacteriological knowledge This is difficult to understand, for, at any rate in his later years, he was a splendid technician, and frequently exhibited beautiful cultures of bacteria We are inclined to think that his failure to make any bacteriological discovery of the first rank was due to the fact that he arrived on the field just a few years too soon When he began the investigation of disease the methods in vogue were microscopic only. Cultivation was practically unknown or carried out by methods now admitted to be insufficient. Bacteriology really emerged through the genius of Koch, and at a time when Klein was labouring with the old methods Had he been in a position to become associated with a master of technique like Koch, he must with all his skill have succeeded in grasping at least one of the golden prizes which were falling into the hands of the workers in Germany and France

There is a good deal of evidence in Klein's writings that his control experiments were too scanty or incomplete, and this led him to hasty conclusions on more than one occasion Although it is to be regretted that Klein had not the luck to make a really important discovery in bacteriology, he exercised a profound and beneficial influence in England on the applications of the science to public health problems, and may be said to have controlled this branch for nearly half a century in a manner which was greatly to his credit In personal intercourse with the younger workers he was always most helpful and generous, and placed his great experience at their service All the memories of him in the country of his adoption will remain favourable. He was a tall, handsome man who spoke broken English to the end Of affable manners, he was often polemical, but took defeat in a thoroughly sportsman-like fashion Throughout life he showed the characteristics of his race in a passion for music and chess

W B

HUGO VON SEELIGER, who died on December 2, was born at Bielitz-Biala, Austria, on September 23, 1849. After studying at the universities of Heidelberg and Leipzig, he was appointed observer at Bonn Observatory in 1873 and remained there for four years, taking part in the observations of the zone 40°-50° for the Astronomische Gesellschaft Catalogue, and being a member of the expedition to observe the 1874 transit of Venus. After a short period at Gotha he went to Munich in 1882 as Director of the Observatory and professor of astronomy He remained there for the rest of his life, and became famous as a teacher, Schwarzschild having been one of his pupils. He also made several theoretical researches both on stellar problems and those relating to the solar system. He was a pioneer in the application of statistical methods to the study of star density, and the size and shape of the stellar system, his estimate of the absorption of light in space was 0 3 mag in 12,000 light years He was interested in the excess of the motion of Mercury's perihelion over its theoretical value He examined whether any distribution of the matter forming the zodiacal light could explain this, without introducing other anomalies in the motion of the nearer planets Another study related to the brightness of Saturn's ring Basing his work on Maxwell's deduction that the ring was composed of small particles, he obtained expressions for its change in brightness at different distances from opposition, which were verified by Muller's photometric observations.

WE regret to announce the following deaths

The Right Hon Sir Thomas Clifford Allbutt, K C B, F R S, Regius professor of physic in the University of Cambridge since 1892, on February 22, aged eighty-eight

Mr T H W Idris, president in 1903 and 1904 of the British Pharmaceutical Conference, on February 10, aged eighty-two.

Sir T Edward Thorpe, F R S, emeritus professor of chemistry in the Imperial College of Science and Technology, South Kensington, and president in 1921 of the British Association, on February 23, aged seventy-nine

Current Topics and Events.

THE President and Council of the Royal Society decided at a meeting on February 19 to recommend for election into the Society the following fifteen candidates Dr W R G Atkins, Prof C A Lovatt Evans, Mr R H Fowler, Dr F A Freeth, Dr. Walcot Gibson, Dr Harold Jeffreys, Prof F Wood Jones, Prof J Kenner, Prof E Mellanby, Mr J A Murray, Prof J Proudman, Mr R V Southwell, Dr L J Spencer, Dr R J Tillyard, Prof R Whiddington

THERE has been so much adverse criticism of the Wireless Telegraphy and Signalling Bill recently introduced by the Postmaster-General that we are beginning to wonder whether after all something cannot be said in favour of it Every one must admit that some control of "etheric" waves is absolutely necessary, even if the terms in which the Postmaster-General asks for authority are open to question Scientific men, although they know perfectly well what the framers of the Bill mean by "etheric waves," have taken a Puckish pleasure in destructive criticism of the nomenclature. When asked to give a scientific definition they have to confess their inability. A proposal has recently been made for a large and powerful radio station which will control the time-keeping of clocks Railway engineers want to use radio signalling to control their trains It is obvious that if some one were not put in authority, the ether—if there is an ether—would soon be in a chaotic condition. If anything affects telegraphy or telephony, the Postmaster-General has been given in the past, and still possesses, the most absolute powers to prevent this interference taking place. During the War, the public welcomed the autocratic powers given to the Post Office. If there were another war these powers would be at once resuscitated for the public benefit The Bill has been in preparation for two or three years, and most of those affected by it have been consulted If suitable amendments be introduced so that the regulations do not affect amateur research injuriously, and section 7, which perhaps goes too far in putting the methods of radio power transmission under the control of the Post Office, be suitably amended, we see little to criticise in the Bill Regulations are always grievous at the start, but they may nevertheless be for the public good.

IT is of interest, just now, to recall the connexion of the Royal Society with various experiments made in 1664 from the steeple of old St. Paul's, under the guidance of Robert Hooke. Oldenburg, the Society's secretary, writing to Boyle, on August 25, 1664, reports that having found the top of Paul's steeple a convenient place for experiments, order was given at the previous day's meeting of the Royal Society (held at Gresham College) to try there the descent of falling bodies, the Torricellian experiment, and the vibrations of a pendulum suspended so as to reach to the floor of the church, a perpendicular height of about 200 ft. Hooke began at once to make trials, enlisting, as helpers, "some other company," which, we gather, included Lord Brouncker, Dr. Wilkins, Sir Robert Moray and Dr Goddard Hooke comments on sundry difficulties in a letter to Boyle, dated Sept 8, 1664 He says. "the steeple being without any kind of lofts, but having here and there some rotten pieces of timber lying across it, I caused a rope to be stretched quite cross the top, and fastened, in the midst of which I fixed a pulley, through which I let down the string and weight to the bottom, for only in the very middle of the steeple was there a broad clear passage from top to bottom" The vicissitudes of issue of the "Philosophical Transactions" have curious connexion, too, with old St Paul's and the Great Fire of London in 1666 The Royal Society's printers (Mr Martyn and Mr Allestry) and the booksellers in St Paul's Churchyard lost their stock of books in the conflagration, after carrying them from their own houses into St Faith's Church, under St Paul's Among the losses were all the copies then printed and unsold of the "Philosophical Transactions" It is small wonder that early copies of this scientific journal are rare

WE have recently had occasion to consider in these columns the recommendations of the Departmental Committee on the Use of Preservatives and Colouring Matters in Food. The Minister of Health has now published draft regulations based on these recommendations, and in framing them he has apparently adhered closely to the latter. The preservatives formaldehyde and boric and salicylic acids are completely prohibited benzoic acid and sulphur dioxide are allowed in certain cases only and in strictly limited amounts The following may contain sulphur dioxide sausages, jam, fruits, beer, cider, wine and cordials and fruit juices· benzoic acid is only permitted in coffee extract, fruit juices and cordials and sweetened mineral waters, including brewed ginger beer; but no article is permitted to contain both sulphur dioxide and benzoic acid As regards colouring matters, all colours which are compounds of the following metals are prohibited: antimony, arsenic, cadmium, chromium, copper, lead, mercury, zinc In addition, gamboge and half-a-dozen coal-tar dyes, including picric acid, are also forbidden Further to protect the consumer, it is laid down that sausages, jam, and coffee extract must be labelled if they contain preservative, whilst articles sold as preservatives must be labelled with the percentage of sulphur dioxide or benzoic acid present. The regulations will apply to imported as well as to home products Full powers are taken to carry out inspections and take samples. The regulations, when put in force—no date is as yet mentioned—should do much to improve the quality of Great Britain's foodstuffs

THE American Association for the Advancement of Science has about 13,000 members, and in his address as retiring president (*Science*, January 2), Dr. Charles D Walcott considers how this great body can render science of service to mankind It should, he says, "act as a liaison agency between professional science and the public, as well as between the various sciences" Whether it be in the traffic and social problems of modern life, or in the conservation of

natural resources, the great need is the education of all citizens in the scientific method of approach "All scientific men and women may do their bit—first, by training themselves to observe accurately, to think straight, and then to record clearly and honestly, and to draw warranted conclusions based on the facts presented , second, by reviewing the mass of technical information with which they are familiar and telling the story they have learned in simple, clear language, free from obscure, complicated, technical and verbose wording ' They should engage in co-operative public work, applying the scientific spirit in all branches of social endeavour, and notably in all agencies concerned with the education of the people from the university to the cinema Could not, Dr Walcott concludes, the Association organise a committee to deal with the popularising of scientific knowledge, bringing its lessons and its principles home to all—and particularly to children, to women, and to business men? This is admirable counsel, and just as applicable to those on the eastern side of the Atlantic as to Dr Walcott's fellow-citizens.

AT the sale of the Crisp Collection of antique microscopes on February 17, high prices were realised for some of the instruments The silver "universal" by G Adams was obtained by Mr Webster for 360*l* This instrument, on account of its highly ornamental construction, its scientific interest, and the fact that it is made throughout of silver, was easily the most valuable item from the auction point of view The original modification of the Hooke microscope, dating from about the year 1675, realised 160*l* The name of the maker of this very fine early example of English opticians' work is unknown An original compound microscope made by Guiseppe Campani, the great Italian optical instrument maker, was obtained by the Science Museum, South Kensington, for 45*l* Other instruments of historical and scientific value secured for this museum included the improved "universal" microscope by G Adams, the Cuno form of hand microscope made by Depovilly of Paris, and a modified form of John Marshall's microscope For the new Museum at Oxford, several instruments were obtained, including a replica of Hooke's original compound microscope, as figured and described in his "Micrographia," 1665 This item realised 20*l* Mr. T. H Court, whose valuable collection in the Science Museum is well known, secured a large number of the instruments Of these, the elaborately decorated microscope made for Pope Benedict XIV (31*l*.), the very fine microscope made in 1752 by D Joannes de Guevave (33*l*), and an early Italian microscope inscribed "Elaboratum a Blasis Burlini Venetiss Optico" (31*l*), may be mentioned Three fine examples of the Marshall microscope, made in the early part of the eighteenth century, were sold at prices ranging from 13*l*. to 22*l*.

PROF. T H. PEAR, in a discourse at the Royal Institution on Friday, February 20, on "Acquiring Muscular Skill," stated that his purpose was, first, to examine an urgent practical aspect of the problem; the desirability of describing and recording skill in a universally acceptable language and notation The photographic, stereoscopic, cinematographic, and ultra-rapid cinematographic study of the ideal postures and movements desirable in certain skills, and the result of describing and discussing such records in words, have occasionally led to a degree of "intellectualisation" which is not generally recognised The accidental fact that some skills have been more fortunate in their exponents partly, but only partly, accounts for this By the aid of these various devices and of certain utilisations of "picture-diagrams" and films it is possible not only to record actual performances, but also to criticise them analytically The study of modern figure-skating in the international style is a good illustration of this point Suitably prepared diagrams should help the learner, before he attempts to execute a complicated series of movements, to grasp them visually, both in parts and as a whole This method of transmitting skill is probably in its infancy Its progress in the hands of suitable instructors should be rapid Whether such visual means of approach to the mind are specially suitable only to the person who "thinks in pictures" is an important and unsettled problem By these means it should be possible to compose new skilled movements and new combinations of them Before the days of musical notation and of writing, musical composers and poets had to be performers Nowadays they may inspire other more gifted executants. This may be possible for skilled movements when a combination of workers, players, anatomists, physiologists and psychologists produce a grammar, a syntax, a harmony and a recorded poetry of movement

IN his presidential address to the Optical Society on Thursday, February 12, Prof Archibald Barr referred to the optical instrument maker as the tool-maker for all branches of scientific investigation including his own He stated that scientific investigators depend to a great extent on the knowledge and skill of the optician for the provision of their tools Every improvement made in the optician's products enables the user of these tools to go farther and deeper in his researches It is the duty of the optician to keep himself familiar with the latest advances in science, so as to be ready to forestall the needs of the investigator, or to be able fully to understand the requirements that arise, and to bring to bear on the production of the new tools an intimate knowledge of the means by which, and the extent to which, the requirements can be fulfilled in a practicable device Opticians are primarily concerned with less than one octave out of the sixty or more of known radiation, though for some purposes they have to take account of one or two octaves on each side of that of visibility, into the infra-red and the ultra-violet. Narrow as it may be on the scale of radiology, the one octave of the visible spectrum has and always will have a very special significance in the scheme of things as they are, and that octave includes a wide range of problems of all degrees of complexity Within the limits of optics properly so called, there is still scope for development to which no limits can be set.

PROF WILLY WIEN, of Wurzburg, has been elected an honorary fellow of the Physical Society of London.

MR. E HILTON YOUNG, M P, has been appointed chairman of the Departmental Committee on the University of London, in succession to Lord Ernle, who has resigned

DR LOUIS A BAUER, director of the department of terrestrial magnetism of the Carnegie Institution of Washington, has been elected a corresponding member of the Russian Academy of Sciences

WE learn from *Science* that Mr John F. Stevens, of New York City, has been awarded the John Fritz Gold Medal of the Engineering Foundation, New York, "for great achievements as a civil engineer, particularly in planning and organising for the construction of the Panama Canal, as a builder of railroads and as administrator of the Chinese Eastern Railway."

A TEMPORARY assistant and a temporary junior assistant are required in the metallurgical research department of the Royal Arsenal, Woolwich Candidates should be graduates with university training in metallurgy Applications for the posts should be sent, with copies of not more than three testimonials, to the Chief Superintendent, Research Department, Royal Arsenal, Woolwich, S.E 18.

A TECHNICAL assistant is required at the Royal Aircraft Establishment, South Farnborough, Hants, for experimental and development work in connexion with aerial beacons and aerodrome illumination generally Candidates should possess an honours degree in electrical engineering, design experience in the application of optical and illuminating engineering, and, if possible, experience in lighthouse work Applications, marked A 47, should be sent to the superintendent of the establishment

APPLICATIONS are invited for the position of organising secretary to the standing committee on special libraries and bureaux of information His duties will consist of attending meetings of the standing committee and its executive, the compilation of a directory of special libraries and intelligence bureaux in the United Kingdom, and preparation for the second conference to be held in September 1925 Applications giving full particulars, and endorsed "Special Libraries," should be sent to reach Mr J. G Pearce, Central House, 75 New Street, Birmingham, not later than March 10

THE annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S W 1, on Wednesday and Thursday, March 11 and 12, commencing each day at 10 A M Twelve communications are due for presentation at the meeting The annual dinner will be held at the Trocadero Restaurant on Wednesday, March 11, at 7 P M Amongst those who have accepted the Council's invitation to be present at the dinner are the Right Hon Neville Chamberlain (Minister of Health), the Right Hon. the Lord Morris (vice-chairman, Imperial Mineral Resources Bureau), and the presidents of many kindred societies

DR H C WILLIAMSON has been appointed to investigate the salmon of British Columbia at Prince Rupert Dr Williamson was a distinguished student and graduate of St Andrews as well as holder of a research studentship of the Exhibition of 1851. Trained in fisheries work at St Andrews, then for nearly two years at Naples, and afterwards in Germany, he entered on the scientific work of the Fishery Board for Scotland equipped as few have been with special knowledge and experience For twenty-eight years he has carried on a continuous series of researches, illustrated by his own skilful pencil, on food-fishes, edible and other crustaceans, and has made careful experiments on the eggs of salmon and herring in connexion with their transmission to the antipodes, besides other fisheries' subjects, and has at present a work on fishes in the press The loss of a highly trained scientific investigator in Scottish fisheries, following so soon after the retirement of his able senior Dr Fulton, is unfortunate for the Department, yet Canada will be the gainer Dr Williamson's publications in the Reports of the Fishery Board extend from 1893 to the present year

THE council of the Institute of Chemistry announces that the Meldola Medal for 1924, awarded for meritorious work in chemistry during the year, has been awarded to Dr Leslie J Harris, of the School of Biochemistry and Emmanuel College, Cambridge Dr Harris's investigations have been concerned largely with the theoretical basis of acid-base titrations and in special relation to amphoteric electrolytes His results have been published mainly in a series of papers appearing in the Proceedings of the Royal Society, B, during the past few years He has shown that the protein constituents, amino-acids, may be estimated from a consideration of their individual acid and basic constants, by titrating within definite P_H limits The same principle has been utilised also by Dr. Harris for estimating proteins and other ampholytes Recently he has shown that such methods are of general application in chemistry, and serve to estimate substances containing the feeblest basic or acidic groups, it having previously been supposed that acids or bases of less than a certain strength were incapable of estimation by acidimetry. Incidentally he has disproved for many cases the theory of acid-base binding at peptide linkages, and he has brought forward fresh data upon the ionic nature of the protein molecule Denaturation of proteins he has shown to involve a chemical change which occurs at a hitherto undescribed sulphur grouping in the protein molecule Dr Harris has also carried out investigations upon milk and infant nutrition.

IN the notice of the second edition of "An Introduction to the Study of Cytology," by the late Dr. L. Doncaster (NATURE, February 14, p 224), the reviewer regretted that the scope of the book was not enlarged We understand from Mr J. Gray that the omissions mentioned are entirely due to the fact that their inclusion would have involved a considerable increase in the cost of the book It seemed desirable to keep the book within the means of the average

student, and this would not have been possible in a new edition including even a brief account of recent knowledge of cell inclusions and somatic cells The new edition has recently been translated into Italian by Prof L Cognetti de Martiis, of the University of Turin, and can be purchased for seven shillings

As a result of the amalgamation of the Ipswich Scientific Society and the Ipswich and District Field Club, there has been formed, under the presidency of Mr J Reid Moir, the Ipswich and District Natural History Society The honorary secretary is Mr F W Brinkley, 31 Oxford Road, Ipswich Fortnightly meetings are held, taking the form of lectures in winter and spring and excursions in the summer, and various sections, each under the guidance of a "leader," deal with different aspects of the Society's activities The Society claims a membership of about 250, and it is hoped to issue shortly the first volume of Proceedings According to the programme for the 1925 session, Sir Charles Sherrington, president of the Royal Society, who is himself associated with Ipswich, has consented to become patron of the Society, and there is little doubt that the sympathy and encouragement expressed by his interest in the Society will do much to promote appreciation of the value of science in the neighbourhood

IN addition to the Monthly Bulletin of the Hawaiian Volcano Observatory, a weekly *Volcano Letter* is now issued Each letter contains the Kilauea report for the previous week on the volcanic phenomena and on the earthquakes recorded at the Observatory, in addition to miscellaneous news On its reorganisation a short time ago, the Volcano Research Association was placed under the U S Weather Bureau It has now (since last July) been transferred to the U S Geological Survey Since 1920, it has established earthquake stations at Kone, Hilea, and Hilo, all in Hawaii, in addition to the central observatory at Kilauea, it has conducted boring experiments at Kilauea, equipped a chemical laboratory at the Observatory, and maintained a research fellowship at the station for one year It is now engaged in preparing for publication the scientific results of its fifteen years' work on the volcano

WE have received No 2 of *Brighter Biochemistry*, the illustrated journal of the Biochemical Laboratory, Cambridge As its title implies, it is a product in a lighter vein than is usual in biochemical journals it contains short articles in prose and rhyme, contributed by various members of the staff of the Laboratory, whose identity is revealed by the initials at the foot of each contribution As might be expected, a local colour is reflected from most of the articles, and some of the allusions will probably only be fully appreciated by those who have an intimate acquaintance with the members of this school and their works Perhaps the most amusing contribution is a short one in verse, entitled "The Great Push another version," giving a brief, though doubtless accurate, account of recent experiments conducted by one of the staff of the Laboratory A series of cautionary tales for biochemists, and the story of John Montgomery Wardley, are other good things in the number, whilst, as might be expected, blood sugar methods and their authors—we had almost said perpetrators—have not escaped satire at the hands of those who have to use them

THE German Scientific and Medical Association (Gesellschaft deutscher Naturforscher und Aerzte) has been greatly encouraged by the success of the Innsbruck meeting in September last No general meeting will be held in 1925 Severe economy is still necessary A meeting at Dusseldorf is planned for 1926 *Die Naturwissenschaften* has been made the organ of the Association, and monthly communications are distributed with this journal The issue of November 21 was devoted to the proceedings of the Innsbruck meeting and included the lectures delivered at the joint meetings of the Society, together with the more important of those delivered to the medical and natural science sections. Men of science of all shades will find something of interest in one or other of these lectures, for the range of subjects covers a wide field A thousand members have accepted the offer of a reduced subscription rate to this journal The membership subscription is 5 marks in Germany, 50,000 kroner in Austria Foreigners may send notes or cheques in registered envelopes to the G D N A at Chemie-Treuhandgesellschaft, Berlin W 10, Sigismundstr 3 For all other business the Secretariat is at Leipzig, Nurnberger Strasse 48[1] Publications are issued through the Hirschwaldsche Buchhandlung, Berlin, N W, Unter den Linden 68

WE have received Nos 9-10 of vol 1 of the *Bulletin d'Histologie Appliquée*, edited by Prof. A Policard, of Lyons It contains original papers on physiological and pathological histology, a section on methods, a critical review, and a bibliographic index It is well printed, but the illustrations could be improved considerably A somewhat original feature is a quotation from some author after each paper the excerpts cover a variety of subjects, from the use of a theory (Gide) to a diet for white rats (Steenbock) The number contains four original papers. A Lumière and R Noel describe the lesions produced in guinea-pigs by the actual method of killing, and conclude that simple bleeding by cutting the carotids, or removal of the heart and lungs after opening the thorax, produce the least alteration in the tissues, all asphyxial methods cause congestion and hæmorrhages. E Grynfeltt describes the erectile tissue in the fimbriæ of the Fallopian tube, by means of which the abdominal ostium of the latter can be brought close to the ovary Mlle A Van Herwerden gives a short account of a reversible gelation produced in the protoplasm of the living tadpole by means of weak acetic acid H E. V. Voss describes the ossification and calcification sometimes observed in portions of ovary grafted into the testicle or kidney of a male guinea-pig, and concludes that connective tissue cells are responsible, typical osteoblasts not being observed In the section on methods, A Ch Hollande discusses the oxidase reaction, and finds, as the result of his experiments, that the formation of indophenol blue

in cell-granules is not diagnostic of the presence of an oxidase in them, since the granules take up the blue colour when the dye itself is presented to them. The actual formation of the blue colour, however, shows that oxidases must be present in the cells or their surroundings M Bernheim reviews the functions of the germ centres of Flemming in the lymph-glands, and concludes that they play an important part in the defence mechanism of the body. The bibliographic index is under headings such as embryology, tissue culture, etc, sections v to ix appearing in this number

THE Medical Supply Association, Ltd., 167-185 Gray's Inn Road, London, has recently placed on the market a compact X-ray outfit of unusual design It is described by them as the "Radiosearch" Complete X-ray Apparatus and is intended for general laboratory work Electricity at 70,000 volts is supplied by a small oil-immersed transformer, enclosed in a rectangular wooden box with ebonite top, which stands in front of a hard-wood panel about three feet high From the upper part of this panel two well-separated stout porcelain insulators project horizontally and forwards To the end of one of these a practical type of milliampere meter with open scale is attached, while the other column carries a variable resistance by which the heating current for the Coolidge tube may be adjusted while the apparatus is in action, a dial enabling the setting to be noted The high tension leads from the secondary of the transformer are suitably connected to these instruments and pass on over spring pulleys to the X-ray tube itself The tube is the self-rectifying radiator "Coolidge" with current-carrying capacity of 10 milliamperes at 70,000 volts. It is held axially within a cylindrical box with only the electrode sleeves projecting on either side The arrangement, adequately protected with lead rubber, is mounted upon a separate and portable table stand so as to enable a beam of X-rays to be projected in any desired direction The outfit is well and strongly constructed Its simplicity and solidity are distinct features, and there seems little to get out of order with reasonable care It should be noted that no means is provided for the variation of the potential difference at the tube terminals. An attachment can, however, be supplied for this purpose at an additional cost It would also make the outfit more complete for experimental work if a sphere-gap with resistance were fitted so that the potential difference across the tube could be directly measured Most physicists using the set, however, would probably prefer to make this measurement by means of an X-ray spectrograph

Our Astronomical Column.

ENCKE'S COMET.—*Astr. Nach* No 5345 contains some observations by G A Tikhov of Pulkovo on the spectrum of Encke's comet made on Oct. 20, 1914 (46 days before perihelion), and Oct 4, 1924 (27 days before perihelion) An objective prism was employed The following are the intensities of the principal bands, on a scale from 1 to 10

Wave-length	Intensity 1914.	Intensity 1924	Source
388	10	10	Cyanogen
405	8	4	
473	1	6	Carbon
516	.	1	,,
563	..	1	,,

The 1924 spectrum is of a type often found in comets That of 1914 is unusual in the feebleness of the carbon bands, which is perhaps due to the longer interval before perihelion The continuous spectrum is weak, especially in 1914

THE NATURE OF SPECTROSCOPIC BINARIES.—According to the theory of binary stars, there is a simple relation between the period and the semi-amplitude, K, of velocity variation This relation involves the masses of the stars, but by assuming an average mass, and treating the stars in groups, it becomes possible to investigate this relation without introducing serious errors This has been done by Dr O Struve in the *Astrophysical Journal*, vol 60, p 167, who has found that for spectroscopic binaries with periods greater than 2 5 days, the relation between P and K agrees satisfactorily with theory The Cepheid variables have comparatively small values of K which show no relation to the periods—thus incidentally affording evidence in favour of the pulsation theory, which assumes that Cepheids are not true binaries In adddition, the author has discovered an interesting group of stars (to which he has applied the rather unfortunate name of "Pseudo-Cepheids") which closely resemble the Cepheids in the behaviour of K These are all spectroscopic binaries of short period (less than 2 5 days), and if they are to be regarded as true binaries, the peculiar behaviour of K would seem to imply either that the total masses are very much smaller than the average, or that the mass-ratios are very large—neither of which assumptions is supported by evidence from the long-period binaries

The evidence brought forward by Dr Struve thus seems to show that short-period spectroscopic binaries may be classed in two groups, some, characterised by large values of K, are true binaries, while others (the more numerous group) are probably not binary stars at all, and bear a close analogy to the Cepheid variables

THE DIAMETER OF VENUS.—*Astr Nach* No 5348 contains three articles on this subject by members of the staff of the Berlin-Babelsberg Observatory It is a matter of considerable interest, owing to Venus being the only known orb that closely resembles the earth in size The measures are difficult, owing to the extreme brightness of the disc, which produces irradiation, the amount of which is difficult to determine, it has generally been assumed that the amount of irradiation in arc is constant at all distances of the planet, but the researches here described (by G Struve, J Dick, and A Kuhl) show that this assumption is untenable They used the large Babelsberg refractor with various powers up to 1000. G. Struve's final diameter is 17 523″ at unit distance, comparing this with the usually adopted value for the earth, 17 61″, we see that the planet's diameter is less than that of the earth by some 40 miles only. That, however, may be modified if the visible disc of Venus is bounded by a cloud surface, as this is likely to be some miles higher than the solid ball of the planet.

Research Items.

ANCIENT ROCK-SCULPTURES IN THE LIBYAN DESERT.—A journey of considerable geographical interest across the southern Libyan Desert from Bara to Bir Natrun in Dongola Province is described by Mr. D. Newbold in *Sudan Notes and Records*, vol. 7. At an early stage of the journey, the author witnessed the departure of the Kababish on their great seasonal migration, when the tribe moves some 20,000 camels and 150,000 sheep and goats to the "gizzu" or grass country for six months. Evidence of early occupation of the country crossed was abundant, including cairns, pottery, some of which was afterwards identified as Meroitic, a small brick pyramid at Abu Sofian, and a find of five glauconite implements of neolithic type. Rock sculptures were first found at Zobat el Hammad, where drawings roughly incised on boulders showed tailed and phallic men, elephants, giraffes, ostriches, oryx, cattle, and several other animals which could not be identified. At Um Tasawin on the return journey, the cliffs, even in the most inaccessible positions, were found to be engraved with innumerable figures of cattle, giraffes, elephants, oryx, and other indeterminate animals. There were also a number of human figures, some tailed, some armed with bows, a few phallic and one steatopygous. At Abu Sofian, two groups of pictures, obviously of the same date and "school," were within a day's march of one another. Here the drawings were incised on round boulders, and were very numerous. Camels are shown literally in hundreds of drawings; giraffes and ostriches still appear; but the cattle dwindle in numbers, while the elephant is not represented and the bowmen give place to men armed with spears and carrying shields. The absence of the camel at Tasawin and el Hammad suggests that the drawings there cannot be later than the first century B.C. They may be the work of the Southern Libyan Tamahu, the ruling caste in Ethiopia in the Meroitic period, and might be dated any time from 300 to 750 B.C. or even earlier. The Abu Sofian groups are obviously later, as shown by the presence of the camel, but must equally be the work of Libyan artists, and are probably between 1500 and 2000 years old. The archaeological evidence as a whole supports the theory of continued migration into the northern Sudan of desert peoples of the west and north-west from the earliest times, and the introduction thence of a Hamitic element into the riverain populations, which is still strongly marked.

SEX-TRANSFORMATION IN BIRDS.—Crowing hens have long been known, but the first case of the complete transformation of a hen which had laid eggs into a functioning male was described by Crew in 1923. Gatenby and Brambell (*Journ. of Genetics*, Vol. 14, No. 2) have added to the list of less complete transformations. They describe a white Leghorn hen which developed the comb and wattles and part of the behaviour of a male. This was accompanied by a great accumulation of fat on the viscera, together with the presence of testicular tissue. Apparently in birds such transformations only take place from the female, which is the heterozygous sex, to the male. The writers discuss the relation of such cases to the chromosome theory of sex determination. Cunningham (*Sci. Progress*, Jan. 1925) has also discussed the problem of the sex characters of birds in its general bearings on the Lamarckian theory and other questions. He refers to the condition in certain breeds of fowls in which the cocks are henny-feathered. Morgan showed that the castration of such cocks causes the development of the normal cock-feathering. Punnett suggested that the hen-feathered condition of the cocks in these breeds is due to the presence of a non-sex-linked factor which causes the testis to develop a hormone suppressing cock-feathering, which is normally produced only by the ovary. Cunningham proposes an explanation of this condition based on the assumption that non-disjunction of the sex chromosomes has taken place, so that in a heterozygous Sebright Bantam hen, the sex chromosomes would be WZZ and not WZ. The test of this hypothesis by examining the chromosomes would be extraordinarily difficult because of the large number and variable form of the chromosomes in the chick. Morgan considered that his castration experiments removed the necessity for a theory of sexual selection or Lamarckian inheritance to account for somatic sexual characters. Cunningham points out certain objections to this view and emphasises, for example, that the pad of a frog's foot is not merely a by-product of a hormone producing some other character, but is definitely related in position and structure to the use to which it is put.

OOGENESIS IN A CENTIPEDE.—S. D. King (Sci. Proc. Roy. Dublin Soc., xviii. pp. 29-36, 2 plates, Nov. 1924) records observations on oogenesis in *Lithobius forficatus*. Yolk-formation in the oocytes takes place by extrusion of particles (the fate of which has not yet been determined) from the central nucleolus, and later by fragmentation of the nucleolus, the particles of which, after proliferation, grow into the definitive yolk-spheres. The Golgi bodies and the mitochondria do not take any direct share in yolk-formation. The mitochondria are at first diffuse, but become concentrated in the early stages of growth, when they form in the oocyte several clusters, some of which proliferate very rapidly, giving rise to round bodies which are not comparable to the yolk-nuclei of ascidians or to the mitochondrial masses described in the oocytes of insects. Later the mitochondria become evenly distributed in the cytoplasm. The Golgi apparatus behaves in the usual way; in the youngest oocytes it is concentrated, but later spreads through the cytoplasm and breaks into fine granules.

SEASONAL CHANGES IN THE WATER OF PONDS.—Messrs. W. R. G. Atkins and G. T. Harris (Sci. Proc. Roy. Dublin Soc., 18, pp. 1-21, Nov. 1924) compare the seasonal changes in the heleoplankton of two fresh-water ponds with alterations in the solutes, and show that in each pond there is a vernal rise in P_H followed by a period of stagnation with lowered P_H. In one pond this condition persisted until the autumn, but in the other—Staddon reservoir—it was succeeded by a period of high alkalinity lasting until October. These changes are associated with the spring increase in plankton and the development of masses of floating algæ in the reservoir. In both ponds the supply of phosphate is exhausted in spring and this sets a limit to the further growth of algæ, but phosphate increases again in winter, partly by regeneration and partly by the inflow of water rich in phosphates. It is highly probable that lack of phosphate, rather than of nitrate or of ammonium salts, limits the plankton in fresh water as it does in the sea. The rapid increase in plankton in the spring is associated with the increase in light rather than in temperature.

CULTIVATING A PLANT "VIRUS" IN VITRO.—Peter K. Olitsky, of the Rockefeller Institute of New York, has a note in *Science* for December 26, pp. 593-4, which will attract the attention of plant pathologists. In experimental work with the mosaic disease of

tobacco, he has drawn about 0 01 c c of the juice from infected plants, by careful technique with sterile pipette, etc, and inoculated this into a medium consisting of the fresh aqueous extract, prepared from carefully selected tomato plants free from mosaic The medium then, in seven to ten days, showed "a faint, uniform, translucent, almost imperceptible haze" No microscopic technique revealed definite formed elements in the medium, but as the result of dilution by subcultural methods, the conclusion is reached that at dilutions far beyond that at which the original 0 01 c c of virus containing sap would still be active, successful inoculation of the disease could be achieved These results are particularly interesting as being obtained with the virus of tobacco mosaic, upon which Allard carried out his well-known experiments showing the filterable nature of the virus, and its highly resistant nature to heat and ordinary precipitants, etc The more detailed account of these experiments that is promised will be awaited with interest

SILVER LEAF ON RHODODENDRONS—Mr A D Cotton has a record in the *Gardeners' Chronicle* of February 14 of the appearance of silver leaf upon rhododendrons in cultivation in Great Britain. The characteristic silvering of the foliage is missing, but after removal of the dead and dying branches, fructifications of *Stereum purpureum* developed upon the stumps The disease seems to spread very slowly in the wood of the rhododendron, but there seems little doubt that in some of the cases observed by Mr Cotton the organism was acting as a parasite and responsible for the dying back of the branches Now that attention has thus been directed to the attack, doubtless other growers of rhododendrons will pay special attention to signs of dying back of branches in rhododendrons.

VARIATION IN BLUE-GREEN ALGÆ—In a paper on variation and species in Cyanophyceæ, Mr W B. Crow (*Journ Genetics*, vol. 14, No. 3) describes observations and cultures of these organisms and draws a number of interesting conclusions The cell structure in this group of unicellular and filamentous algæ is very simple, there being no true nucleus or karyokinetic division, and sexuality is also absent Mr Crow correlates the continuous variation with these features The systematic differences are shown to be similar to those variations produced by changes of environment in cultures The characters of the group are regarded as belonging entirely to the kind called by Gates organismal, the absence of karyogenetic or Mendelian characters being correlated with the absence of nuclei and sexuality. Various parallelisms in variation with Isokontæ and other groups of algæ and fungi are also pointed out, and the general constancy of the forms when grown artificially is emphasised Such studies are valuable for comparison with the genetics of higher organisms

THE ORIGIN OF THE CYCADS—English botanists, remembering the caution with which that veteran palæobotanist Dr D. H Scott now speaks, will read with some scepticism the confident pronouncement with which the address of Prof C J Chamberlain, chairman of Section G of the American Association for the Advancement of Science, commences (*Science*, January 23) Prof Chamberlain is quoted as saying that "the widest gap in the evolution of plants used to be the one between the ferns and seed plants, but the researches of the past thirty years have bridged the gap so completely that the two groups are now separated only by the artificial definitions of the taxonomist" None is better qualified, however, than Prof Chamberlain to discuss the salient features of structure and distribution in the Cycadales, and with reference to the deficiency of our knowledge of their fossil history, there will be general agreement that at the present day a study of distribution of a group in geological times may often be a study of the distribution of the enthusiastic and trained palæobotanist In exemplifying this thesis Prof Chamberlain pays a well-deserved tribute to the productive labours of the American palæobotanist Prof. Wieland

SURVEY WORK IN NORTHERN CANADA—The Topographical Survey of Canada is pushing its work farther north every summer and has parties at work in the barren lands and the northern islands of the Arctic Archipelago Some notes in the Journal of the Dominion Land Surveyors Association by Mr G H Blanchet give a preliminary account of the drastic changes in the map that accurate survey is making in regions relatively so accessible as the Great Slave Lake and the upper part of the basin of the Coppermine River and Backs River The position and extent of Lakes Clinton-Colden, Aylmer, Mackay and de Gras up to the present have figured on maps chiefly from hearsay reports Last summer Dominion surveyors found them very much out of position and corresponding but little with previous notions The party found the outlet of the upper Coppermine River from Lac de Gras, but was unable in the short season to go down the valley Another paper in the same publication notes the beginning of surveys in and around the new station of the Canadian Mounted Police in Ellesmere Land, Devon Island, and Ponds Inlet.

THE PROBLEM OF ATMOSPHERIC ELECTRICITY—The issue of the *Physikalische Zeitschrift* for January 1 is a Jubilee number of 92 pages It contains an account of the life and work of Georg Hirzel, by whom the *Zeitschrift* was planned and founded in 1899, with Profs Riecke and Simon of Gottingen as editors The issue also contains an account by Dr R Seeliger of the report on the fundamental problem of atmospheric electricity made by Prof Hans Benndorf to the meeting of the German Scientific and Medical Association at Innsbruck The variation of electrical potential with height in the atmosphere and the electrical conductivity of the atmosphere itself imply a flow of electric current to the earth, which for the whole earth amounts to about 1000 amperes To explain how this current is maintained has been the problem of atmospheric electricity for some years It has, however, been reduced to insignificance by the larger problem raised by the measurements of Dr L A Bauer, who finds that the lines of magnetic force on the earth's surface necessitate a current of about 3 million amperes Prof Benndorf ascribes this current to β-rays from the sun too swift to produce ionisation of the atmosphere

DIRECTIONAL QUANTIFICATION IN A MAGNETIC FIELD—Prof W Gerlach describes, in the F Paschen "Festschrift" of the *Annalen der Physik* published in January, an improved apparatus for studying spatial or directional quantification, and so measuring the magnetic moment of the atoms of metallic vapours. With copper, silver, and gold, the vapours of which are monatomic, the magnitude of the shift of the atomic stream in a magnetic field shows that they behave exactly as single quantum atoms, or more generally, as atoms with an apparent (effective) moment of one magneton, should do according to the theory Thallium vapour is also monatomic, but the magnetic effect in this case is much smaller. There is no magnetic effect for lead or tin, though lead vapour

is monatomic and the same is probably true of tin vapour, this is partly due to the low temperature employed, though it was high enough in the case of tin to have enabled ±0 5 of a magneton to be observed Bismuth and antimony vapours consist wholly or partly of molecules and multiple molecules, a definite theoretical explanation of the results is therefore impossible for these metals Nickel vapour is monatomic, the experiments show that in the normal state the atom has a magnetic moment of several units, 0 and ±i magnetons (i about two) have been proved certainly, apparently there are also atoms with still higher moments The result of the magnetic analysis is rather complicated, and it is hoped that it will be possible to obtain a more complete analysis of the plates for this metal There were considerable experimental difficulties in the case of iron, and the appearances expected from a consideration of its spectrum could not be obtained in the plates

THE X-RAY ABSORPTION BAND HEADS OF NICKEL AND OF ZINC —A method of determining the wave length of an X-ray absorption band head is described by Dr W Walter in the *Zeitschrift fur Physik*, December 31 An X-ray tube is used, giving a line spectrum with numerous lines, one of which lies as near as possible to the wave length of the band head to be measured When the X-rays are passed through screens made of the element to be investigated, lines corresponding to longer wave lengths than this show no absorption, while those corresponding to shorter wave lengths are strongly absorbed In the case of nickel, the following table gives the estimated intensities of three lines, photographed directly, and after passing through nickel filters *b* and *c*.

Line	$\lambda \times 10^{11}$ cm	Intensity		
		a	*b*	*c*
Ni_β	1497 03	10	10	10
$W_{\alpha'}$	1484 52	8	5	2
W_α	1473 48	50	8	1
Thickness of filter, mm	...	0 0000	0 0095	0 0163

Ni_β is not absorbed by nickel, since its wave length is greater than that of the band head, which according to Kossel's theory must have a wave length a little smaller than that of the K_γ line of nickel, $1485\ 4 \times 10^{-11}$ cm The $W_{\alpha'}$ line satisfies this condition, and it will be seen that its behaviour agrees with its lying in the band head, since the relative change of intensity caused by the filters is considerably less than in the case of W_α, which lies well inside the absorption band Duane and Hu give 1489 0 for the position of this band head, which is clearly much too large Similar results were obtained for zinc, though in this case the X-ray tube employed gave no line which agreed so closely with the position of the band head as in the case of nickel The difference between the value obtained and that of Duane and Hu is considerably greater for zinc than for nickel

NEW SYNTHESIS OF UREA —Dr K C. Bailey, in the Proceedings of the Royal Dublin Society, November 1924, describes a new synthesis of urea from carbon dioxide and ammonia The mixed gases, preferably in the ratio 4 1, are passed at atmospheric pressure through the annular space between two concentric tubes, the outer, quartz, tube being heated to 500-700°, and the inner, glass, tube being kept water-cooled The yield increases with temperature up to at least 700° C.

OXY-CELLULOSE —In the Journal of the Textile Inst, vol 16, No 1, January 1925, Constance Birtwell, Douglas A Clibbens, and Bert P Ridge publish as Part I of "The Chemical Analysis of Cotton" a comprehensive study of oxy-cellulose. As the result of carefully controlled oxidation of cotton with mild oxidising agents, they are able to analyse the different results of such agents upon cotton cellulose, and they point out that two main types of oxy-cellulose should be distinguished In one type, the product resulting from oxidation shows great affinity for methylene blue and high retentive power for alkalis, this type of oxy-cellulose is not chemically altered by boiling in dilute alkali The other type of oxy-cellulose has enhanced reducing properties, best measured by the weight of copper reduced under standard conditions This type loses entirely its chemical characteristics as an oxy-cellulose on boiling with dilute alkali, losing abnormally in weight at the same time; it is afterwards indistinguishable chemically from pure cotton cellulose, though the physical properties, *e g* tensile strength, may be altered Which type of oxy-cellulose is produced predominantly during the technical process of bleaching depends chiefly upon the acidity or alkalinity of the hypochlorite solution; on the alkaline side of the neutral point the product tends to be of the first type, with high absorption of methylene blue and low copper number, on the acid side the type with high reducing power is obtained.

FLOW AND RUPTURE OF METALS DURING CUTTING. —The report of the Cutting Tools Research Committee of the Institution of Mechanical Engineers, read on January 23 by Dr W Rosenhain and Mr A C. Sturney, contains an account of experiments made to determine the behaviour of material in the vicinity of the edge of the cutting tool, and is illustrated with several unique photomicrographs of cross sections taken through chips in process of formation By using a simple type of cut and varying only two factors, namely, depth of cut and top-rake angle, certain definite regularities of behaviour have become manifest. According to the conditions of cutting, the separated metal takes the form of three distinct types of chip (*a*) the "tear" type, in which rupture of the metal occurs by the formation, well in advance of the nose of the tool, of a tear or crack tending to run inwards from the periphery of the stock Since such a tear cannot progress very far, a succession of fresh starts are made by the tool, and the surface of the work is left in the form of rough projections, each of which probably corresponds to successive shearing of the chip (*b*) When the conditions are changed by either reducing the depth of cut or increasing the top-rake angle, or both, the ultimate result is the formation of the "flow" type of chip (*c*) Intermediate conditions produce an intermediate type called the "shear" type, since it is formed mainly by a process of shearing on a plane making an angle of roughly 30° with the direction of motion of the tool. So far as the present investigation goes, it indicates that the best results in cutting in regard to the removal of the maximum amount of metal per unit distance of tool travel, the least irregularity of surface, the closest agreement between intended and actual depth of cut, and the minimum wear of tool, are obtained by using a top-rake angle a very little smaller than that at which the heavily deformed zone before the nose of the tool just disappears, in conjunction with the greatest depth of cut which still allows the formation of the flow type of chip.

The Future of the Motor Ship.

By Engineer-Capt EDGAR C. SMITH, O.B.E., R.N.

THE introduction of the "Otto" cycle for gas-engines by Nicolas August Otto in 1876, the construction of the compact light spirit engine by Gottlieb Daimler in 1884, and the publication of his memoir, "The Theory and Construction of a Rational Heat Motor," by Rudolf Diesel in 1893, are three of the landmarks in the history of the internal combustion engine The first led to a great extension in the use of gas-engines, the second paved the way for the motor car and aeroplane engine, while Diesel's work gave us the most efficient of modern heat engines Just as the petrol-engine has revolutionised transport by road, so the Diesel engine bids fair to revolutionise transport by sea Otto died in 1891, Daimler in 1900, and Diesel was drowned in the North Sea in 1913, but each lived long enough to see his work bearing good fruit.

Diesel, who was born in Paris of German parents in 1858, was induced to take up the study of thermodynamics by von Linde, and ultimately assisted Linde in his work on refrigerators He also worked in the shops of the well-known firm of Sulzer Brothers of Winterthur, and after completing his theoretical investigations was enabled to build an experimental engine Many interesting details of his early work were given by Diesel himself to the Institution of Mechanical Engineers in 1912, but it was his account of a 20 H P engine communicated in 1897, which first attracted general attention, and it was then that, upon the advice of Lord Kelvin, a Scottish firm of engineers took up the manufacture of Diesel engines Though, like the steam turbine of Sir Charles Parsons, it found its first useful sphere in the power-houses of the day, its application to ships was only a matter of time, and after being used in various craft, a Diesel engine was fitted in the *Toiler* by the Tyne firm of Swan, Hunter, and Wigham Richardson, and in 1911 that vessel crossed the Atlantic

The *Toiler* was but a small vessel of 3000 tons carrying capacity and 360 horse power, but she was soon followed by the *Jutlandia* and *Selandia*, engined by Burmeister and Wain of Copenhagen, and then by the British vessels *Arum*, *Arabis*, and *Abelia*, all three of which were the victims of German submarines during the War At the beginning of the War in 1914 there were nearly three hundred Diesel-engined ships afloat. The War, however, hindered progress in this direction, but during the last year or two much greater strides have been taken, and there are now nearly 2000 motor ships of a total tonnage of 2,000,000 tons, and about half the ships under construction to-day are designed for driving by Diesel engines It is true this 2,000,000 tons is but about a thirtieth of the world's tonnage, but the facts are significant, and many consider that what the Americans have called the "Dieselisation of the sea" has definitely set in

How the steam reciprocating engine and the steam turbine are being displaced can be seen from the following figures, gleaned from the returns of Lloyd's Registry of shipping, which show the tonnage classed each year and the types of machinery adopted

Year	Steam Reciprocating Engine	Steam Turbine	Oil-engine
	Tons.	Tons	Tons.
1918–19	2,633,570	1,051,302	75,934
1919–20	2,821,031	1,286,046	79,805
1920–21	2,373,067	754,513	101,608
1921–22	1,420,524	870,037	226,552
1922–23	842,358	603,037	165,229
1923–24	610,851	99,464	164,336

In view of these facts, especial interest attaches to the presidential address of Sir Westcott S Abell, the chief ship surveyor of Lloyd's Registry, to the Institute of Marine Engineers, delivered on February 10, and to the lecture of Sir Fortescue Flannery to the Royal Society of Arts on the following day "The Motor Ship in the Light of the History of Marine Propulsion" was the title of Sir Westcott Abell's address, while Sir Fortescue Flannery took as his subject "The Diesel Engine in Navigation" So firmly convinced are both authors that the Diesel engine is the ships' engine of the future, that the former remarked that "the disappearance of the steam-engine from overseas trade is largely a matter of time," while Sir Fortescue Flannery said that an examination of the figures "gives support to the belief that in a comparatively short time the Diesel engine will almost wholly displace the steam boiler at sea"

Though both containing the same conclusions, the two addresses were very different in character Starting with the point of view that the Diesel engine has demonstrated its reliability—an essential feature in any marine engine—Sir Westcott Abell discussed what he termed the economic efficiency of the motor ship At present, Diesel engines cost much more than steam machinery, and the cost of the oil per ton is enormously greater than the cost of coal per ton But the reduction in the amount of fuel expended is so great that "with the present availability of and cost of oil fuel there is a distinct margin in profit in favour of the Diesel-engined ship compared with the coal-fired boiler and the steam-engined vessel" Sir Westcott's figures and diagrams illustrate this point, for with a ship of 8000 tons deadweight carrying capacity, the oil-engined ship can carry 10 per cent more cargo than the steamship Discussing the mechanical and thermal efficiencies possible with modern machinery, Sir Westcott Abell comes to the conclusion that even with the heavy Diesel engine at present fitted, where only 5 B H P is obtained for every ton of machinery, "the principal economic gain arising from the introduction of the Diesel engine has already been obtained" The problem now is "to devote considerable attention to obtaining the maximum simplicity, gaining thereby in reliability and ease of maintenance" Also, there are the auxiliaries, in which many improvements can be made. Among the diagrams illustrating the address is one showing the decline of the sailing-ship and the rise of the steamship, and it will be interesting to see if the Diesel engine supersedes the steamship in the same way

The crowded lecture-room of the Royal Society of Arts and the gathering of distinguished shipowners, shipbuilders, and engineers on the occasion of Sir Fortescue Flannery's lecture were ample testimony to the importance of the subject The interest of the occasion was increased by the presence in the chair of Lord Bearsted, the pioneer of the present-day system of carriage of petroleum in bulk in tank steamers The lecture was a review of the introduction of the use of oil and the action of the Diesel engine, and contained explanations of the types of Diesel engines, of which there is a somewhat bewildering variety Compared with a good steam plant, which uses about 1 8 lb of coal or 1 4 lb of oil per B H P. per hour, the Diesel engine burns about 0 4 lb Apart from the saving in the fuel bill, a Diesel-engined ship can go farther afield or more cargo can be carried All early motor ships had twin screws, but experience has shown the oil engine to be reliable and single screws are now being fitted where suitable Sir

Fortescue Flannery dealt with the main points in the different designs of single-acting and double-acting, and of four-stroke and two-stroke engines such as the Burmeister and Wain, North British, Tosi, Vickers, Werkspoor, Doxford, Fullagar, Polar, and Sulzer, and also of that most interesting development, the Still engine, which is a Diesel engine and steam-engine combined Developments are still proceeding with rapid strides towards the double-acting type and the consequent increase of power in proportion to the weight, but there is at present no approach to the standardisation such as is attained in the triple-expansion engine

During the course of the evening, Lord Bearsted read a characteristic letter on the oil question from the late Lord Fisher, written in 1911, and he also gave some figures respecting the oil-engines suitable for a light cruiser. The cruiser, it is true, would have a speed of 26 knots as against a speed of 28 knots of her sister ship with steam machinery, but she would have a very much greater radius of action He seemed to think that the Admiralty has not done so much as it might to further the progress of the oil-engine for propulsion

In the discussion that followed, Engineer Admiral Sir Robert Dixon, the Engineer-in-Chief of the Fleet, recalled the work done in the Navy on the Diesel engines for submarines and referred to the experimental plant founded at West Drayton Before an oil-engined battleship is feasible, however, the Diesel engine must give far more power for its weight than those in existence at present

It may be remarked that even the late Lord Fisher would scarcely have cared to command a light cruiser of 26 knots, even if fitted with oil-engines, when trying to overtake an enemy ship of the same class with a speed of 28 knots In building the famous *Dreadnought*, a thousand tons in weight and 100,000*l* in money were saved by the adoption of steam-turbine machinery, but there seems little prospect at present of doing anything similar by the adoption of Diesel engines in a man-of-war.

The Effects of Posture and Rest in Muscular Work.[1]

THE problems of muscular activity have been investigated for many years from an academic viewpoint, yet it is only in recent times that a demand has arisen for the application of exact means of measurements of the physiological cost of muscular work in industry. The Medical Research Council's report for the years 1923–24 states that "The studies of muscle function which were almost notorious for their supposed uselessness to the student or physician have laid down basic knowledge which now underlies many parts of medical science and art, and are beginning to remove empiricism from practical studies of physical training and of industrial labour"

The output of energy of an individual may be calculated by measuring the amount of oxygen and carbon dioxide present in the expired air, and from these data the physiological cost of the work can be assessed This method of estimating the "cost" of work or muscular activity places at our disposal a means of comparing the efficiency and capacity of the human machines under different conditions

Two methods are available for the measurement of energy output—(*a*) direct and (*b*) indirect calorimetry The unit of measurement used is the large or kilo calory In direct calorimetry the individual is enclosed in a special chamber so constructed that the heat given off is measured The apparatus is also arranged for the collection of the expired air, so that direct and indirect calorimetry may be combined.

In indirect calorimetry the subject wears a mouth-piece fitted with two valves One valve serves for inspiration, while the other valve allows the expired air to pass down through a wide tube into a rubber bag, which the subject carries during the experiment The expired air can be drawn off and analysed in a Haldane apparatus The ratio of carbon dioxide given off to oxygen absorbed can then be obtained, and from these data the heat units are calculated If the measurements are carried out on the subject at rest and during work, an exact estimation can be made of the energy required for this particular task

In a recent publication of the Industrial Fatigue Research Board on "The Effects of Posture and Rest in Muscular Work," Miss E. M Bedale has investigated the energy expenditure of a woman carrying loads in different positions Miss Bedale has used the indirect calorimetric method for estimating the physiological costs of the work It is shown from the measurements made that the energy expenditure varies with the position in which the load is carried The physiological cost of carrying with a yoke is low and involves less physiological disturbance than any other The experiments suggest that the continuous carrying of a load exceeding 35 per cent of the body-weight is likely to cause rapid impairment of working capacity A series of photographs of the different modes of weight-carrying bring out the importance of the study of body posture Some of the methods, if used continually, will rapidly lead to body deformities, with impairment of the normal physiological functions The use in industries of methods least injurious to the body would be an aid in the prevention of disease, and undoubtedly lead to greater efficiency The results of further investigations will be awaited with interest The data collected will tend to remove empiricism from studies of industrial labour, and will give a standard of measurement more accurate than that of output

Prof E P Cathcart contributes a preface which deals in a clear and concise manner with methods of measurement, and points out the pitfalls which beset the investigator in work of this type

In the same publication, Dr H M Vernon gives the results of an investigation on "The Influences of Rest Pauses and Changes of Posture in the Capacity for Muscular Work" The conclusions drawn by Dr Vernon suggest that the promotion of circulation plays an important part in the prevention of fatigue, the value of a rest pause being increased if the worker moves about during the interval Postural changes during work are shown to be as necessary as rest pauses if efficient work is to be carried out

An interesting point is raised concerning the effect of additional movements during muscular work The application of motion study to industrial processes has resulted in the elimination of many unnecessary movements and a marked increase in output The results now obtained suggest that the removal of too many unnecessary movements may be too drastic, and even better results might be obtained if a few extra movements, sufficient to promote circulation, were allowed. The proof of this suggestion will probably only be obtained by investigating each process separately by the old method of trial and error.

[1] Medical Research Council Industrial Fatigue Research Board Report No. 29 "The Effects of Posture and Rest in Muscular Work (*a*) Comparison of the Energy Expenditure of a Woman carrying Loads in Eight Different Positions," by E M Bedale, (*b*) "The Influence of Rest Pauses and Changes of Posture on the Capacity for Muscular Work," by Dr H M Vernon. Pp 55 (London H M Stationery Office, 1924) 2*s* 6*d* net.

University and Educational Intelligence.

BRISTOL —Last year the Council set aside a portion of a bequest from the late Mr H. H. Wills for the purpose of providing additional staff and equipment in the Department of Physics when the erection of the Henry Herbert Wills Physics Laboratory is completed Though the building is not yet ready for occupation, it has been decided to create a readership in mathematical physics as from August 1, and Dr J E Jones has been appointed the first reader.

CAMBRIDGE —Mr Ll. H. Thomas, Trinity College, and Mr H. Horrocks, St Catherine's College, have been elected to Isaac Newton Studentships in astronomy and physical optics

EDINBURGH —At the meeting of the University Court on Monday, February 16, a letter was read from Sir Richard Lodge intimating his resignation from the chair of history as from the end of the current academical year The Principal expressed great regret on behalf of the Court In Sir Richard Lodge the University had an ornament of whom it was proud and an invaluable helper in every branch of University activity His departure would be a severe loss not only to the School of History, which owed its present high reputation to his unremitting efforts, but also to the whole University, to the interests of which he had devoted his great abilities during a period of more than twenty-five years

Mr W Oliver was appointed to be the first occupant of the chair of the organisation of industry and commerce, which was founded by a recent Ordinance of the University Court

It was intimated that the Senatus had unanimously resolved, on the recommendation of the Faculty of Medicine, to award the Cameron Prize for the year 1925 to Prof R Magnus, the Royal University, Utrecht, Holland This prize, of the value of about 200*l*, is awarded annually to a person who in the course of the five years immediately preceding has made a highly important and valuable addition to practical therapeutics

The resignation, as from September 30, of Mr W. L Ferrar, lecturer in mathematics, on his election to a tutorial fellowship at Hertford College, Oxford, was accepted.

LEEDS —Dr T. Wardrop Griffith has placed before the Council of the University his resignation of the professorship of medicine

Prof T. Wardrop Griffith was appointed to the chair of anatomy in 1887 and transferred to the chair of medicine in 1910 He began work in the old Medical School in Park Street and took an active share in the construction of the new School in Thoresby Place, in which he established one of the best anatomical departments in Great Britain

OXFORD —There will be an election at Keble College on March 16, on the results of an examination, to a Natural Science Scholarship on the Gibbs Foundation, of the value of 80*l*. per annum Candidates must be more than twenty years of age on March 16, and if already members of the University, of not more than two terms of University standing on that day. By the terms of the benefaction, the scholarship is tenable only by members of the Church of England Inquiries should be addressed to Mr G. D. Parkes, at Keble College, on or before March 2.

SHEFFIELD —Applications are invited for the chair of mining They should be sent to reach the registrar by, at latest, March 31.

DR W. HIEBER, of Wurzburg, has been appointed director of the department of inorganic chemistry at the University of Jena.

A NUMBER of scholarships in connexion with Bedford College for Women, Regent's Park, N W 1, are being offered, particulars of which are obtainable from the principal.

APPLICATIONS are invited for two posts at Auckland University College, New Zealand, namely the professorship of forestry and a lectureship in civil engineering Particulars may be had from the High Commissioner for New Zealand, 415 Strand, W C 2

THE Leathersellers' Company's Technical College, 176 Tower Bridge Road, S E 1, invites applications for the post of chemical lecturer and demonstrator. Candidates must possess a good science degree, but a knowledge of leather is not essential

THE annual general meeting of the Association of Technical Institutions will be held at the Institution of Mechanical Engineers, Storey's Gate, London, on Friday and Saturday, March 6 and 7 The proceedings will commence with a reception by the acting president, Mr W H Patchell, which will be followed by the presidential address of the president elect, the Right Hon Lord Montagu of Beaulieu Friday afternoon and Saturday morning will be devoted to the consideration of business matters and the reading of papers by The Right Hon Lord Emmot and Principal W M. Varley, on "The Local College and its relation to surrounding Education Authorities", Mr. G Mavor, Head of the Department of Continuative Education, Loughborough College, on "Training and Education for Apprenticeship", Mr J E Montgomrey, assistant secretary of the Institution of Mechancial Engineers, on "The Working of the Schemes for National Certificates and Diplomas in Engineering." Sir John Dewrance is entertaining members of the Association and others attending the meeting to luncheon on Friday, March 6, at the Trocadero Restaurant

THE Royal Technical College, Glasgow, has received a gift of 50,000*l* from an anonymous donor, who has given the governors of the College complete freedom to expend the revenue derived from it as they may see fit The industrial depression in the south-west of Scotland, particularly severe in the engineering, shipbuilding, and iron and steel industries, with which the College is closely associated, has resulted not only in a diminution in the number of local students, although it has still double the number of the regular students of session 1913–14, but also there has been less capacity on the part of the industries to give financial support to the College There is little doubt that the wise and far-seeing policy of the late Sir George Beilby, who was chairman of the governors for many years and the guiding spirit in the remarkable development of the College, both in its teaching organisation and the provision made for research work, has led the anonymous donor to consider the College worthy of this most welcome addition to its resources Sir George Beilby's connexion with the College is to be marked by the foundation of a memorial medal in technical chemistry and by the generous gift by Lady Beilby of his excellent organ, which is to be reconstructed and placed in the College hall Other recent donations are the continuance by the Bellahouston Trustees for another three years of an annual grant of 1000*l*. which they have given during the past five years, and substantial additions to the electrical engineering equipment in the form of modern machines presented by about twenty leading British firms of electrical engineers.

Early Science at Oxford.

February 29, 1683/4 Dr Wallis was pleased to inform us, that ye way commonly used in opening frozen pumps, with salt, has been known to make pumpwater, under his house, apt to curdle in boiling, and unfit for washing, which naturally is fit for use, and bears soap very well, but ye water probably will recover itself as soon as ye salt shall be drawn off

Dr. Pit acquainted ye Society, that sallet oyl cannot be made to boyl over, this has been observed by late experiments, and will give some light to that custom of ye sugar boilers, who used to throw a piece of sewet, candle, etc into their sugar, and by these means keep it from boiling over

Some Queries concerning the splitting of Trees by ye late great frost, were brought in by Dr Plot they are as follows:—Whether any of these trees have split with a noise? Whether they are split quite through, or only on one side? Whether they are all split to ye same point of ye Compass? Whether ye splitting be more common in ye Trunk, or in ye Boughs? Whether any Ice has been found in ye vessels of ye wood? Whether ye trees split be any of them dead? Whether any of ye trees split have closed since ye thaw? Whether ye Bark be loosned by ye splitting, from ye wood?

Dr Wallis mentioned vast numbers of dead Congers, which were thrown up by ye sea, at Dim-Church wall, along ye coast of Kent, during the late hard frost, as also about eight years ago, the same was observd on ye Severn shore in Somersetshire, about twenty years ago

March 1, 1686/7. Upon mentioning of Mr Hooke's Discourse about the changes which he supposes to have been made upon the surface of the Earth, Mr President observed that the latitude of Oxford is not sensibly altered in these four hundred or five hundred years last past, as appears by the Alphonsine Tables and some MSS in Oxford, in which though there may be about one minute more, or one minute less than ye present latitude, yet that may well be attributed to the unaccurateness of the observations —It was stated at this meeting that the age of one Mother George, now living in Oxford, is about one hundred and eleven years

March 2, 1685/6. Dr Plot shewed ye Society two Swedish Runestocks or Primestocks, and one book almanack, also severall old English almanacks, of which some were for families, others for private persons, some of brasse, others of wood, all perpetuall

March 3, 1684/5. Mr Leigh gave a farther account of ye Balsamic Earth It will take fire at a candle, and, if tost in ye air, will burn exactly like a torche, an oyl dropping from it scarce distinguishable from ye oyl of amber Any other earth whatsoever, if put into ye place, where this is dug, will in a year's time be exactly the same with this 4 drops of this oyl is a present Cure for ye Colic, and may therefore in all probability be proper in those distempers, which affect the nerves

A letter from Mr John Aubrey, dated London Feb 27, mentioned an opinion that some merchants were of, that beasts are generally offended at a Barbary Lion's skin There being one of these skins in ye Musæum Ashmolianum, he desires, ye truth of this matter may be enquired into, which was ordered to be done

March 6, 1687/8 An account was delivered of what appeared to Mr Pit upon the dissection of a *dog*, that had Mercury injected into one of the jugulars The mercury was thrown out of the blood into the cavity of the abdomen, as likewise some appearance of it in the other cavitys of the body

Societies and Academies.

LONDON

Royal Society, February 19 —O W **Richardson** and A F A **Young** The thermionic work-functions and photoelectric thresholds of the alkali metals The photoelectric threshold for normal potassium is close to 7000 Å U, which agrees with the known wave-length of maximum activity λ_{max} and the equation $\lambda_0 = \frac{3}{2}\lambda_{max}$ Uncertain traces of a thermionic threshold agreeing with this have been found at about 200° C in one experiment, but the thermionic thresholds usually effective at this and lower temperatures are of a much lower magnitude, even under the best vacuum conditions A common thermionic threshold effective at about 200° C corresponds to λ_0 = about 10,000 Å U A photoelectric emission with this infra-red threshold has been got by exposing potassium to a luminous discharge in hydrogen or water vapour This may be due to the growth of small patches normally present There is no evidence of photo-electric activity further out in the infra-red, although there is a thermionic threshold which corresponds to λ_0 = 30,000 Å U The glow discharge not only brings out undeveloped thresholds, but it also augments the normal emission —J H **Brinkworth** On the measurement of the ratio of the specific heats using small volumes of gas The quantity actually measured is the cooling effect in adiabatic expansion, *i e* the ratio of the drop in temperature to the drop in pressure These two quantities are measured directly, the former by using a suitable platinum thermometer, and the latter from the readings on an oil gauge The values of the ratio of the specific heats thus experimentally obtained are used for the calculation of the specific heats of air and of hydrogen The specific heat of air at constant pressure is practically constant, and equal to 0 2395 cal/gm. ° C over the temperature range 155° to 290° A The molecular heat of hydrogen falls rapidly from 4 88 at 290° A to 3 30 at 90° A None of the theoretical curves representing the variation in the molecular heat of hydrogen agrees with the experimental curve, the divergence, at some temperatures, being certainly five times greater than an outside estimate of the inaccuracy of the experimental results —F H **Constable** The catalytic action of copper Part VI Chemical reaction occurs only when an alcohol molecule is adsorbed over a characteristic arrangement of copper atoms, called a reaction centre There is a large variation in the number of atom centres lying beneath one adsorbed alcohol molecule on various crystal faces, thus the reaction centre density varies also The activity of the surface is controlled by the exponential activation factor, and by the reaction centre density on the surface —Part VII The rate of dehydrogenation of ethyl and butyl alcohols has been studied at pressures from 10 cm of mercury to two atmospheres The reaction velocity was found to be independent of the pressure —V H **Stott, Edith Irvine,** and D **Turner** Viscosity measurements with glass For the range 10^6 to 10^{17} poises, the apparatus is a modification of the method of Trouton and Andrews, in which the resistance to torsion of a circular rod is determined This apparatus may be readily modified so as to extend its applicability down to 10^4 poises Measurements of lower viscosities down to about 10^2 poises depend on determinations of the rate of fall through the glass of a partially counterpoised iridio-platinum ball. Temperature uniformity in the latter case has been achieved by the use of an electrically heated "black body" furnace possessing novel features —W G **Palmer** and F. H

Constable The catalytic action of copper, Part V The reaction velocity-temperature curves for ethyl, *n*-propyl, butyl, *iso*butyl and *iso*amyl alcohols (which have in common the grouping $-CH_2OH$) are identical within the limits of experimental error This identity involves also the equality of the temperature coefficients and of the heats of activation The higher alcohols caused rapid "poisoning" of the catalyst, but this secondary effect was circumvented —P. A M **Dirac** The adiabatic invariance of the quantum integrals The postulate of the existence of stationary states in multiply periodic dynamical systems requires that if the condition of such a system, when quantised, is changed in any way by the application of an external field, or by the alteration of one of the internal constraints, the new state of the system must also be correctly quantised It follows that the laws of classical mechanics cannot in general be true, even approximately, during the transition During the so-called adiabatic change, which takes place infinitely slowly and regularly, so that the system practically remains multiply periodic all the time, classical laws may be expected to hold In this case the quantum numbers cannot change, and it has been possible to deduce from the classical laws that the quantum integrals remain invariant —D L **Watson** The thermal decomposition of derivatives of oxalacetic ester a unimolecular reaction The decomposition, on heating, of derivatives of oxalacetic ester into a malonic ester derivative and carbon monoxide obeys the unimolecular (or simple probability) law, $dx/dt = k(a-x)$, and the velocity is uninfluenced by diluting with solvents or adding acidic substances, though retarded by high concentration of carbon monoxide None of the substances could be stimulated to react by light of wave-length predicted from the Lewis-Perrin theory, or by ultra-violet radiation, which they absorb very strongly They had energies of activation between 33,000 and 36,000 calories, and an "active life" of the order of 10^{-14} second, in agreement with many other first-order changes The velocity of decomposition of phenyl-oxalacetic ester, however, was proportional to the amount of phenyl-malonic ester formed by the change (except when the latter substance was present in excess) This law, characteristic of simple reactions in pure liquids, may be explained by the hypothesis of "reflex activation," namely, that highly energised products of reaction are largely responsible for formation of fresh "active" molecules Here, as in all known unimolecular reactions, two species of molecules evidently take part in the change —K R. **Rao** (1) On the fluorescence and channelled absorption of bismuth at high temperatures The absorption spectrum has been photographed at temperatures of the order of 1500° C Some of the absorption bands in the visible region exhibit distinctly a fine structure, showing that these are due to the triple quantification. The vapour emitted a fluorescent radiation, and the fluorescent banded spectrum ranging from λ6570-λ5040, containing about 20 bands, shaded towards the red, has been photographed This banded fluorescent spectrum indicates probably that the critical potentials of elements which are polyatomic are related to the molecule and not to the atom —(2) A note on the absorption of the green line of thallium vapour The green line of thallium consists of an intense central doublet accompanied by two satellites Absorption by a column of non-luminous vapour indicates complete absorption of the central doublet at about 800° C, at which temperature the satellite was but very feebly absorbed The total absorption of the satellite took place at about 950° C —B F J **Schonland** The passage of cathode rays through matter Cathode rays of velocities up to 0 55 that of light (100,000 volts) in quantities easily measurable on a galvanometer, were produced These rays have been used to extend measurements of cathode-ray absorption to the β-ray region The difference in variation of apparent absorption with velocity for different elements depends upon the fact that this is not a true absorption, since it includes the effect of the scattering back of rays on the side of incidence The existence of a range for these rays has been established, and the values found for ranges at various velocities in aluminium are in close agreement with those calculated on Bohr's theory of absorption, which has now been tested from $\beta = 0\ 20$ to $\beta = 0\ 90$, with rays of penetrating power varying in the ratio of 1 to 5000 Cathode-ray absorption is due to gradual loss of energy of moving particles by collisions with electrons in matter An examination of the principles underlying Bohr's theory of absorption shows that interchange of energy in such collisions must take place more freely than the usual conceptions of atomic structure allow Absorption of cathode rays of various speeds by atoms of a given element does not appear to show any discontinuities corresponding to those observed in X-ray spectra.

PARIS

Academy of Sciences, January 19 —The president announced the death of L Maquenne, member of the section of rural economy —Maurice **de Broglie** and Jean **Thibaud** The exceptionally intense absorption of a radiation by the atom which has just emitted it. —Maurice **Lugeon** Fluvial erosion Example of the Rio Negro in Uruguay — — **Calichiopulo** The harmonic law of distribution of the errors of observation — — **d'Ocagne** Remarks on the preceding communication —Enea **Bortolotti** Extension of the Beltrami-Enneper theorem to conjugated networks from V_2 to V_3 —D **Mordouhay-Boltovskoy** The primary factors of the integral function.—J **Dufay** and A **Couder** The photometric study of the total eclipse of the moon of August 14, 1924 This eclipse was observed in a clear sky at Saint-Geniez (Basses-Alpes, 1070 metres) At 10′ from the centre of the shadow the stellar magnitude of the moon was, in red light ($\lambda = 0\ 61\mu$), $-2\ 8$ in October 1921, and $-1{\cdot}3$ in August 1924 —J H **Shaxby** The diffusion of particles in suspension As spheres of uniform size the cocci of the pyogenes staphylococcus were utilised, suspended in water The value of the Avogadro number deduced from the experiments was 59×10^{22}. —Beaulard **de Lenaizan** and J **Granier**. The specific inductive capacity of ice The value 2·17 was found for the specific inductive capacity of ice, at a temperature of $-4\ 5°$ C, and with a wave-length in air of 363 2 cm —Marcus **Brutzkus** A new mode of production of chemical reactions —D K **Yovanovitch** and J **d'Espine** The magnetic spectrum of the high-velocity β-rays of thorium B + C Seven of the high-velocity β-rays measured by L Meitner are confirmed three additional rays have been detected for which $H\rho = 6800$, 18,000, and 40,000 These new rays are very faint —Henry **de Laszlo** The absorption of ultra-violet rays by the methyl derivatives of naphthalene The absorption spectra of α- and β-methylnaphthalene, 2 6-dimethylnaphthalene and 2 7-dimethylnaphthalene were measured, and the results are given on a diagram —P **Vaillant** The law of variation with temperature of the (electrical) conductivity of solid salts and its possible relations with the characteristic spectrum of the metal of the salt —Mme Pierre **Curie** The estimation of radium in uranium minerals containing tantalum, niobium, and titanium The mineral is mixed with barium sulphate, fused with

potassium bisulphate, extracted with water and filtered The precipitate on the filter is treated with dilute hydrofluoric acid The insoluble portion containing the radium is boiled with sodium carbonate, to convert the barium and radium into carbonates, and the latter dissolved in dilute hydrochloric acid After concentration to ice, the emanation is removed by a current of air and estimated in the usual manner —Mlle Suzanne **Veil** The evolution of the hydrate of nickel sesquioxide in the presence of water —André **Charriou** The use, in catalysis, of alumina which has absorbed various other substances The decomposition of ether at 250° C in the presence of alumina was studied With one exception, the blue oxide of tungsten, the presence of foreign substances (SO_3, P_2O_5, CuO, CaO, CoO) reduced the catalytic power of the alumina in this reaction —G **Dubar** The formations of the Lias and the upper Jurassic in Asturia —L **Eblé** and J **Itié** The values of the magnetic elements at the station of Val-Joyeux (Seine-et-Oise) on January 1, 1925 —L **Blaringhem** The production of new hybrids between the wild species of Triticum and the principal cultivated wheats Analysis of their affinities —A **Guilliermond**: The instability of forms and the permanence of the mitochondria —P **Delauney**: The glucosides of several species of native orchids —Emile F **Terroine** and Jean **Roche**. Heat production and respiration of the tissues *in vitro* in the homeotherms —A F **Roffo** The action of the Rontgen rays on cholesterol Cholesterol, in solution, is destroyed by the action of the X-rays, but the crystallised alcohol is unchanged by this treatment—Edouard **Chatton** and André **Lwoff** The etiology and structure of the Spirophyra Their relationship with the Fœttingeria The origin and evolution of the parasitism of these infusoria

VIENNA

Academy of Sciences, December 11 —H **Pettersson** Communication from the Radium Institute, No 173 On the reflection of α-particles from atomic nuclei, α-particles were scattered through nearly 180° by five different elements With three of these elements, which are known to be disintegrated, no reflected α-particles were observed, even at ranges considerably smaller than those calculated by the collision-theory. With two heavier elements α-rays were observed, but with much smaller ranges than would correspond to an elastic collision Possible explanations are given on the assumption that the α-particle penetrates into the nucleus. H-particles were detected after bombarding nickel and copper with α-particles —H. **Handel-Mazzetti**: New Chinese plants (30th communication) An index list of some 100 descriptions published during 1924 is given —J **Albrecht** Palæontological and stratigraphical results of the journey of Dr Ampferer and Dr Hammer in Western Serbia in the year 1918 —M **Kohn** and S **Strassmann**: Ninth communication on bromophenols, bromo- and bromo-nitro-phenols.—M **Kohn** and R **Marberger** Tenth communication on bromophenols. On chloro-nitro-ether and bromo-nitro-ether of hydroquinone and of tolu-hydroquinone and the mobility of the halogen atom in the same —M **Kohn** and S **Grim** Eleventh communication on bromophenols Bromination of hydroquinone-monomethyl-ether and of nitro-hydroquinone-dimethyl-ether

Official Publications Received.

New South Wales Department of Mines Geological Survey Mineral Resources, No. 32 The Coal Resources of the Douglas Park Area, and Tabulated List of Coal Bores, Counties of Cumberland and Camden By L F Harper Pp 22 (Sydney Alfred James Kent) 1s

Department of Commerce U S Coast and Geodetic Survey Serial No 277 Radio Acoustic Method of Position Finding in Hydrographic Surveys By Comdr N H Heck and E A Eckhardt and M Keiser (Special Publication No 107) Pp iv+23 Serial No 278 Velocity of Sound in Sea Water By Comdr. N H Heck and Ensign Jerry H Service (Special Publication No 108) Pp iii+27 (Washington Government Printing Office.) 10 cents each

Agricultural Progress the Journal of the Agricultural Education Association Vol 2, 1925 Pp 122 (London Ernest Benn, Ltd) 5s net

British Association for the Advancement of Science Report of the Conference of Delegates of Corresponding Societies, 1924 including List of Papers bearing upon the Zoology, Botany and Prehistoric Archæology of the British Isles By T. Sheppard Pp 489-554 (London British Association, Burlington House, W 1)

The Carnegie Trust for the Universities of Scotland Twenty-third Annual Report (for the Year 1923-24) submitted by the Executive Committee to the Trustees on 11th February 1925 Pp iv+77 (Edinburgh The Merchants' Hall)

Bulletin of the American Museum of Natural History Vol 47, Art 7. Primates collected by the American Museum Congo Expedition By J A Allen Pp 283-499+plates 79 167 (New York City)

The Indian Forest Records Vol 10, Part 11 Burma Oak and Chestnut Tans, being the Report of an Investigation from the Tannin standpoint of the different parts of the various Oak and Chestnut Trees, principally those species growing in the Maymyo and Kalaw Areas By J A. Pilgrim. Pp vi+90 (Calcutta Government of India Central Publication Branch) 1.1 rupees, 1s 6d

Nigeria Third Annual Bulletin of the Agricultural Department, 1st July 1924 Pp 96 (Lagos) 5s

Memoirs of the Colombo Museum Edited by Dr Joseph Pearson. Series A, No 3 Ceylon Coins and Currency By H W Codrington Pp viii+290+7 plates (Colombo) 10 rupees

Publikation der Sternwarte in Kiel 13 Berechnung der Ablenkungen der Lichtstrahlen in der Atmosphäre der Erde auf rein meteorologisch-physikalischer Grundlage Von Paul Harzer Pp 89 14 Gebrauchstabellen zur Berechnung der Ablenkungen der Lichtstrahlen in der Atmosphäre der Erde für die Beobachtungen am grossen Kieler Meridiankriese Von Paul Harzer Pp 23 (Kiel C Schaidt.)

Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No 495 A Radiometric Investigation of the Germicidal Action of Ultra violet Radiation By W. W Coblentz and H R Fulton Pp 639-680. (Washington Government Printing Office) 20 cents

Annual Report of the Director, United States Coast and Geodetic Survey, to the Secretary of Commerce, for the Year ended June 30, 1924. Pp iv+80+21 plates (Washington Government Printing Office) 10 cents

Diary of Societies.

SATURDAY, FEBRUARY 28

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford: The Counting of the Atoms (I)

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7 15 —E. S Rayner Road Passenger Transport.

MONDAY, MARCH 2

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4 30

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

SOCIETY OF ENGINEERS (at Geological Society), at 5 30 —R I Money: Notes on Preparing a Tender

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 5 30 —Dr H E Meleney Kala Azar in China, with special reference to its Histo pathology in Experimentally Infected Hamsters

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at South Wales Institute of Engineers, Cardiff), at 6 —L Breach and H Midgley: Drive of Power Station Auxiliaries

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (Annual Lecture), at 7 —W H Patchell A Visit to America

ARISTOTELIAN SOCIETY (at University of London Club), at 8 —J. H. Harley The Theory of the State

ROYAL SOCIETY OF ARTS, at 8 —Dr W Rosenhain The Inner Structure of Alloys (III) (Cantor Lectures)

SOCIETY OF CHEMICAL INDUSTRY (London Section, jointly with the Institute of Chemistry (London Section)) (at Chemical Society), at 8

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street, W), at 8 —F Jones Standardised Rubber-ware.

ROYAL SOCIETY OF MEDICINE (Epidemiology, Comparative Medicine, and Disease in Children Sections), at 8 —G P Male, Dr M. J Rowlands, Dr Stenhouse Williams, Dr David Nabarro, Sir Layton Blenkinsop, and others Special Discussion The Control of Tuberculosis and the Milk Supply

INSTITUTE OF CHEMISTRY (Manchester Section) —Dr A Renshaw: Chemical Poisoning occurring amongst Industrial Workers.

TUESDAY, MARCH 3

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof J Barcroft: The Colour of the Animal Creation (IV) The Colour of Fish

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —E Banks Variation in the Colours of European Birds in relation to the Conditions under which they live —O Thomas, M A C Hinton, and Capt G C Shortridge On Mammals collected in 1923 by Capt Shortridge during the Percy Sladen and Kaffrarian Expedition to South-West Africa With Field-notes by the Collector —Dr C F Sonntag A Monograph of *Orycteropus afer* I Anatomy except the Nervous System, Skin, and Skeleton —Mary L Hett A New Species of Temnocephala (Trematoda) from West Australia —V S Vinogradov The Structure of the External

Genitalia in the Rodents Dipodidæ and Zapodidæ as a Classificatory Character —A Loveridge Notes on East African Scorpions and Solifugæ
Institute of Marine Engineers, at 6.30 —E W L Nicol Fuel Economy
Institution of Electrical Engineers (East Midland Sub-Centre) (at Loughborough Technical College), at 6 45 —R C Clinker The Constants of an Electric Circuit
Institution of Electrical Engineers (North-Western Centre) (at Engineers' Club, Manchester), at 7 —Major E I David Electricity in Mines
Institute of Metals (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7 —J H Russell. Slags and Fluxes their Composition and Uses
Institution of Automobile Engineers (Coventry Centre) (at Broadgate Café, Coventry), at 7 15
Institute of Metals (North-East Coast Section) (at Armstrong College, Newcastle-on-Tyne), at 7 30 —A G Lobley Electric Furnaces.
Hull Chemical and Engineering Society (at Grey Street, Hull), at 7 45 —Dr W M Cramp Pneumatic Transport of Materials
Röntgen Society (at British Institute of Radiology), at 8 15 —Dr L A Levy and D W West The Photometry of Fluorescent Screens

WEDNESDAY, March 4

Royal Society of Medicine (Balneology and Climatology, Epidemiology, Medicine, Therapeutics and Pharmacology Sections), at 5 30 —Dr W Edgecombe, Dr J A Glover, Sir William Willcox, Dr P Hamill, Dr Ackerley, Dr Middleton, Dr Keir Pringle, Sir Percy Bassett-Smith, Dr R Hill, J E R McDonagh, Dr Oliver Heath, Dr C E Sundell, and Dr Higgins Special Discussion on The Nature, Prevention, and Treatment of Fibrositis
The Newcomen Society (for the Study of the History of Engineering and Technology) (in Prince Henry's Room, 17 Fleet Street, E C), at 5 30 —C E Greener Gun Handicraft
Institution of Electrical Engineers (Wireless Section), at 6.—D Dye Current Transformer Methods of Producing Small Known Voltages and Currents at Radio Frequencies for Calibrating Purposes —Lieut -Col. K E Edgworth and Lieut G W N Cobbold · The Measurement of Frequency and Allied Quantities in Wireless Telegraphy
Institution of Heating and Ventilating Engineers (at Engineers' Club, Coventry Street, W), at 7 —H W Bannister · Water Softening in relation to Heating and Domestic Hot Water Supplies
Royal Microscopical Society (Biological Section), at 7 30
Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8 —G Van B Gilmour A New Method for the Determination of Butter Fat —R C Frederick The Investigation of Ventilation Conditions —R C Frederick and E R Webster A Simple and Self-contained Spectroscope Lighting Unit.—P K Frohlich The Carbon Error in the Quantitative Deposition of Nickel and Iron from Complex Oxalate Electrolytes
Royal Society of Arts, at 8 —Prof W E S Turner The Modern Production of Sheet-Glass
Entomological Society of London, at 8
Medical Society of London, at 9 —Sir Bernard Spilsbury Wounds and other Injuries (II) (Lettsomian Lectures)

THURSDAY, March 5

Royal Society, at 4 30 —Sir Arthur Schuster The Life Statistics of Fellows of the Royal Society —Prof G I Taylor and Miss C F Elam The Plastic Extension and Fracture of Aluminium Crystals —A. Fage An Experimental Study of the Vibrations in the Blades and Shaft of an Airscrew —J H Vincent and A L Beak Experiments on the Effects of Resistance in the Oscillating Circuit of a Triode —*To be read in title only* —Prof G H Hardy. The Lattice Points of a Circle —Prof H M Macdonald The Transmission of Electric Waves around the Earth's Surface —R M Wilmotte The Field of Force near the Neutral Point produced by Two Equal Coaxial Coils with special reference to the Campbell Standard of Mutual Inductance —W R Dean The Theory of Elastic Stability —R A Frazer The Motion of Circular Cylinders in a Viscous Fluid
Linnean Society of London, at 5 —G C Robson (*a*) Seriation and Symmetry in the Cephalopoda, (*b*) Exhibition of *Opisthoteuthis depressa* (Mollusca) —K. H Barnard Revision of the Family Anthuridæ (Isopoda) with Remarks on certain Morphological Peculiarities —C C Lacaita (*a*) Some Critical Species of Marrubium and Ballota, (*b*) Two Rare Spanish Species of Echium
Royal College of Physicians of London, at 5 — Dr S MacNalty · Epidemic Diseases of the Central Nervous System (Milroy Lectures) (I)
Royal Institution of Great Britain, at 5 15 —Sir Arthur Smith Woodward Dinosaurs
Royal Aeronautical Society, at 5 30 —Lt -Col C B Heald Some Medical Aspects of Air Transport
Royal Society of Medicine (Balneology and Climatology, Epidemiology, Medicine, Therapeutics and Pharmacology Sections), at 5 30 —Dr W Edgecombe, Dr J A Glover, Sir William Willcox, Dr P Hamill, Dr Ackerley, Dr Middleton, Dr Kerr Pringle, Sir Percy Bassett Smith, Dr R. Hill, J E R. McDonagh, Dr. Oliver Heath, Dr C E Sundell, and Dr Higgins Special Discussion on The Nature, Prevention, and Treatment of Fibrositis
Child Study Society (at Royal Sanitary Institute), at 6.—F. C Richards · Art in the Schools.
Institution of Electrical Engineers, at 6 —Col T F Purves The Post Office and Automatic Telephones
Society of Chemical Industry (Bristol Section) (at Bristol University), at 7 30 —M. W Jones Paint and Paint Making (Chairman's Address)
Chemical Society, at 8 —I J Faulkner and Prof T M Lowry Studies of Dynamic Isomerism Part XVII The Mutarotation of Aluminium Benzoylcamphor —Prof. T M Lowry Studies of Dynamic Isomerism Part XVIII The Mechanism of Mutarotation, and of Hydrolytic and Prototropic Change, with a criticism of Baker, Ingold, and Thorpe's Doctrine of Non-intervention —Prof T M Lowry and E M Richards. Studies of Dynamic Isomerism Part XIX Experiments on the Arrest of Mutarotation in Tetramethylglucose
Royal Society of Medicine (Obstetrics and Gynæcology Section), at 8, —Dr J S. Fairbairn and Dr Z Mennell Toxæmia in Early Pregnancy with Jaundice, Hyperemesis and Multiple Neuritis —E Williams and Dr R Reynolds A New Method of Determining the Patency of the Fallopian Tubes by means of X-rays — Dr S Forsdike Investigation of the Uterus and Fallopian Tube by Inflation with Air and X-rays
Society of Dyers and Colourists (West Riding Section) —Prof. F G Donnan Colloids

FRIDAY, March 6

Association of Technical Institutions (Annual Meeting) (at Institution of Mechanical Engineers), at 11 A M —Lord Montagu of Beaulieu · Presidential Address
Royal Society of Arts (Indian Section), at 4 30 —Sir Henry Sharp The Development of Indian Universities
Royal Astronomical Society (Geophysical Discussion), at 5 —Prof S Chapman Magnetic Phenomena in Polar Regions
Philological Society (at University College), at 5 30 —C T Onions Dictionary Evening
Society of Chemical Industry (Manchester Section, jointly with the Liverpool Section) (at 16 Mary's Parsonage, Manchester), at 7 —Dr A Schedler Chemical Constitution and Properties of Azo Dyestuffs
Institution of Mechanical Engineers (Informal Meeting), at 7.—Discussion on Pitfalls for Patentees
Society of Chemical Industry (South Wales Section) (at Swansea Technical College), at 7 30 —E A Tyler Fine Chemicals
Junior Institution of Engineers, at 7 30 —E F Etchells How to apply for a Job and how not to do it
Institute of Metals (Sheffield Section) (at Sheffield University), at 7 30 —J A Lee The Evolution of the Furnace
North-East Coast Institution of Engineers and Shipbuilders (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 — Debate Industrial System, English, opened by K Porter and J Mathieson, *versus* American, opened by T W Worth and H McIvor
Royal Institution of Great Britain, at 9 —Sir Arthur Keith Concerning the Rate of Man's Evolution

SATURDAY, March 7

Association of Technical Institutions (Annual Meeting) (at Institution of Mechanical Engineers), at 11 A.M.
Royal Institution of Great Britain, at 3 —Sir Ernest Rutherford, The Counting of the Atoms (II)
Ipswich and District Natural History Society (at Ipswich) —Dr F W Crossley-Holland Science and the Criminal

PUBLIC LECTURES.

SATURDAY, February 28

Horniman Museum (Forest Hill), at 3 30 —W. J Perry The Ancient Mariners of the Pacific

MONDAY, March 2

St Thomas's Hospital Medical School, at 5 —Prof B P Watson Puerperal Sepsis (I) (Succeeding Lectures on March 3, 4, 5)
Leeds University, at 5 15 —R E Priestley The Glacial Cycle as illustrated by Antarctica
University College, at 5 30 —P Fleming The Story of Regent's Park and Regent Street

TUESDAY, March 3

King's College, at 3 30 —Rev R Hanson The Philosophy of Religion (VI) Is there an *a priori* Religious Judgment?
Imperial College—Royal School of Mines, at 5 30 — Prof C A Edwards Chemical Combination in Metallic Alloys and its Nature (I) (Succeeding Lectures on March 4, 10 11)
University College, at 5 30 —W J Perry The Spread of Culture
Leeds University, at 8 —Prof W Garstang The Terrestrial Zoology of Yorkshire

WEDNESDAY, March 4

London School of Economics and Political Science, at 5 —F Pick The Principles of Design as applied to our Cities and Towns
School of Oriental Studies, at 5 15 —E Richmond Early Moslem Architecture Fatimid Architecture in Egypt
King's College, at 5 30 —Sir E Denison Ross. Travel and Travellers of the Middle Ages (VIII) Travellers' Tales and the Kingdoms of Prester John, A D 1150–1550
University College, at 5 30 —C R Sanderson The Library Resources of London —Prof T B Wood The Nutrition of the Young Animal (I) (Succeeding Lectures on March 11 and 18)

THURSDAY, March 5

University College Hospital Medical School, at 4 15 —Dr C Singer The History of Influenza, Diphtheria, and Typhoid Fever (Succeeding Lectures on March 12, 19)

SATURDAY, March 7

Horniman Museum (Forest Hill), at 3 30 —Miss M A Murray Modern Excavations in Egypt

SATURDAY, MARCH 7, 1925.

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Editorial and Publishing Offices
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Medical Research in Great Britain.[1]

THE Report of the Medical Research Council for the year 1923–24 to the Committee of the Privy Council for Medical Research consists for the most part of a condensed epitome of the results already achieved during the year by research workers wholly or in part financed by the Council. The large number and great variety of the researches undertaken make it impossible to refer to them individually in this article Mention will, therefore, be made of a few subjects only which, either from the completeness of the issue arrived at or from the interest of the results obtained at the present stage of the inquiry, force themselves upon the attention.

Results of far-reaching importance are being achieved by the committee appointed under the chairmanship of Prof J Barcroft to investigate the properties of hæmoglobin, and a paper on the correlation between the spectra of various hæmoglobins and their relative affinities for oxygen and carbon monoxide has recently been published from Prof Barcroft's laboratory in Cambridge Using the Hartridge reversion spectroscope, it was found that a relationship existed between variations in the gas-binding affinities of different hæmoglobins and in the character of the α-bands. These variations appear to be conferred on the hæmoglobin by differences in the protein part of the molecule.

That light was a potent means of disturbing the equilibrium between hæmoglobin, carbon monoxide, and oxygen was confirmed by the investigators engaged in this research, and its action on other biological processes is being intensively studied by many workers at the present time It has been found that the bactericidal power of blood is raised by exposing the skin of the subject to ultra-violet radiation, the exposure causing in some obscure manner a greater avidity of the leucocytes for the organisms with which they come in contact This result may be related to the now well-known beneficial action of sunlight in tuberculous infection in man, an action which is being demonstrated with such success by Rollier at Leysin and by Gauvain in Great Britain

It is not alone in its power of increasing the resistance of individuals to microbic infection that light is being exploited in research schemes at the present time. Rapid progress is being made in the elucidation of the relation between irradiation and dietetic deficiency. It had previously been shown that exposure of rats fed on a diet deficient in fat-soluble vitamins to ultra-violet radiation was capable of bringing about normal growth This effect was found to persist if the containers in which the animals lived were irradiated, and the result was interpreted as pointing to some property

[1] Committee of the Privy Council for Medical Research Report of the Medical Research Council for the year 1923–1924. Pp 142 (London. H M Stationery Office, 1924) 3s 6d net.

conferred by the ultra-violet light on the air in the immediate environment Independent experimentation, however, failed to confirm this; and quite recently the original observers of the phenomenon have come to the conclusion that the positive results obtained by them were due to the presence of sawdust in the glass containers during the period of irradiation When a piece of deal board was substituted for the dust an intermediate rate of growth was found. No precautions were taken to prevent the animals consuming some of the sawdust or gnawing away pieces of the irradiated board; but experiments at present in progress suggest that actual ingestion of the irradiated material is not essential for its beneficial action.

This result, if confirmed, is clearly one of fundamental and far-reaching importance In the experiments referred to, the values for calcification of the bones were found to follow those of growth very closely Whatever the nature of the emanations from these materials after exposure to ultra-violet light may happen to be, it is clear that a whole new field for research is rapidly opening up What substances are capable of "phosphorescing" in this manner? Is vitamin A, the origin of which we know to be absolutely dependent on sunlight, a substance in which the power of absorbing ultra-violet light and converting this energy into a form of emanation having a potent effect in controlling the vital processes of growth and calcification, and is it developed to an extreme degree?

The Standards Department of the National Institute for Medical Research has now practically completed the work involved in the preparation of a stable dry standard of insulin The Toronto unit will be defined in terms of this standard, which should then serve "as a currency for its transmission to all countries"

Much work is in progress on the nature and location of the action of insulin, when injected into animals, in causing the well-recognised fall in the blood sugar concentration. It had previously been shown by two Canadian physiologists that the isolated mammalian heart perfused with Locke's solution caused a fall in the sugar content of the perfusate, and that this fall was accentuated by the addition of insulin. The destiny of this extra quantity of sugar which disappeared remained, however, obscure. The question has recently been reinvestigated at the National Institute for Medical Research Determination of the quantity of sugar disappearing in a given time, and the amount of carbon dioxide produced by the heart during the same period, have shown that in the absence of insulin there is a yield of carbon dioxide greater than can be accounted for solely by the combustion of the glucose removed. In the presence of insulin, however, the reverse is the case.

It is certain, therefore, that under the latter conditions part of the sugar is not oxidised, and at the present time the form into which the sugar has been changed remains obscure. It has been possible, however, to exclude certain hypotheses, such as that of the transformation of some of the sugar into fat, from a study of the respiratory quotient of the decapitated and eviscerated animal under constant infusion of dextrose. In such a preparation, insulin causes the characteristic fall in blood sugar, even when the muscles are inactivated by curare, without any change in the respiratory quotient which remains throughout at unity. Immediate transformation of the sugar into fat, or into lactic acid, seems therefore to be definitely excluded Furthermore, investigations at Cambridge have shown that the heat production of isolated frog's muscle is unaffected by the presence in the surrounding fluid of relatively large concentrations of insulin. Recent work, too, on the sugar consumption of the heart-lung preparation has failed to show an increase in the rate of disappearance of this substance from the circulating blood on the addition of insulin Insulin apparently is essential at some stage on the anabolic ladder of glycogen formation, though it will be clear from the foregoing account that we are still ignorant of the intimate nature of its action

Studies of the excess metabolism of muscular exercise in man over and above the resting level have shown that this, provided the exercise is short-lived, has a respiratory quotient of unity. Experimental evidence all tends towards the conclusion that muscle is capable of metabolising directly carbohydrate alone

It will be apparent from the few foregoing examples of work which is being pursued in the physiological and biochemical laboratories of Great Britain, that these two sciences are extremely virile and rich in productive effort Turning to experimental medicine and clinical research, we find that here again much progress is recorded and "the Council are of opinion that during the past five years these University clinics have wholly justified their foundation by their success" Where the material for research is human, it is unavoidable that advance should be slower than in the sciences contributing to medicine Furthermore, we must remember that the staffs of the medical and surgical units of the London hospitals are not in a position officially to exercise their option as to the type of case admitted to their wards any more than their colleagues on the remaining hospital "firms"

For teaching purposes this is no doubt an advantage, but it must inevitably break any attempt at co-ordinated research into the mechanism of the disturbances which culminate in disease. The first effective trial unit made by the Medical Research Committee, namely, the

Cardiac Department of University College Hospital Medical School, has more than justified its existence This unit is unique in that it is engaged in an intensive study of the physiology, pathology, and nosology of one system only; a fact which is probably not unrelated to the richness of its scientific produce The conception of "capillary pulsation" as a sign primarily of high pulse pressure, and in consequence a common accompaniment of aortic insufficiency, has been shown to be erroneous, the main causative factor of the phenomenon being a "widening of the arterioles of the skin or mucous membrane in which it occurs" The capillaries of the human skin have been shown to be capable of exerting relatively high pressures (from 50 to 100 mm of mercury) when they are stimulated to contract by light stroking of the skin Injury to the skin, on the other hand, leads to a train of vascular changes—dilatation and increased permeability of the minute vessels—which is conditioned by the liberation from the injured cells of a substance akin to histamine. To quote from an original paper,

> "from the simple reactions of a healthy skin to the relatively mild stimuli such as are experienced daily by almost all, through the more serious, though trivial, local injuries, the bruise, the blister and the small scald, which find their simple household remedies, to the most grave mechanical injuries and extensive burns which in their late manifestations endanger life, we pass by transition It begins to be apparent why this transition is throughout a transition of quantity and not of quality, for underlying the whole series of reactions there is seemingly one chief determining cause, the unvarying reply of the affected cell to injury, this response of the cell, protective as it is to the cell itself, when united with that of neighbours, produces a massive action, threatening or terminating the life of the organism as a whole, an example which is not the sole example of conflict between the cell and the community of which it is a member"

In the introductory review by the Council of its second quinquennium, attention is directed to the unsatisfactory position and progress of pathology and bacteriology It is pointed out that in Great Britain this is in part due to the "accidents of historical circumstances," but that "in all countries bacteriology is halting for more intimate knowledge of the infective organisms and of their biochemistry, while pathology only shows promise of advance in so far as it proceeds as a study of the reactions of the body to disturbance, as a part indeed of physiology, and in so far as it can express its phenomena in terms of biochemistry"

The munificent benefactions which these two sciences have recently received at the Universities of Oxford and Cambridge through the generosity of the Dunn Trustees, the Rockefeller Foundation, and Mr. Ernest Gates, coupled with their full recognition by the universities as being sciences laudable of pursuit, will, however, doubtless raise their position rapidly and effectively to the level and productive capability of those sciences which are less directly concerned with the alleviation of human suffering

It is impossible to read this Report of the Council without being impressed with the wide range of its activities and the wisdom it displays in allocating the funds entrusted to it by Parliament for the furtherance of medical research E. B V.

Geography and World Development.

Geography and World Power By James Fairgrieve. Fifth impression Pp viii + 373 (London University of London Press, Ltd., 1924) 5s. net

North America an Historical, Economic, and Regional Geography By Ll Rodwell Jones and Dr P W. Bryan Pp xiii + 537 (London Methuen and Co., Ltd, 1924) 21s. net

Europe Vol 1 · *The Peninsula.* Edited by B. C. Wallis (Stanford's Compendium of Geography and Travel, New Issue) Pp. xxiii + 763 + 40 maps (London Edward Stanford, Ltd, 1924) 15s net.

The New World Problems in Political Geography. By Dr Isaiah Bowman Revised and enlarged edition. Pp vi + 630 + 112 (London, Calcutta and Sydney: G G. Harrap and Co, Ltd, 1924) 21s net.

Elementary Commercial Geography By Dr. Hugh Robert Mill and Fawcett Allen. Pp ix + 194. (Cambridge At the University Press, 1924) 4s

MODERN science has changed the size and shape of the earth Time is the measure of its distances and routes the framework of its shape. London is nearer to New York than to Kashgar, and the Pacific Ocean, once the limits of the Orient and Occident, is now becoming the strategic and economic centre of a new world based upon the universal ocean. The latest development is a bi-weekly service of motor cars across the French Sahara. The adjustment of human activities to physiographic conditions has been in progress from before the dawn of history, and human institutions have shown that they are no more permanent than the "everlasting" hills

The author of "Geography and World Power" defines history in its widest sense on its material side as the story of man's increasing ability to control energy. In a most suggestive book he gives a series of excellent studies, showing how empires and states have developed conformable to certain major phenomena of a physical order, and how a change in geographic values has effected changes in the relative importance of nations Some, no doubt, will quarrel with the word "control," and especially so when it is urged that

"Men may advance or fall behind because the geographical conditions affecting their bodies react on their minds", and again "In the long run the geographical conditions are more powerful than the genius of individuals, more powerful even than racial characters, unless these racial characters are due to geographical controls"

The genius of mankind shows itself in its adaptability to new physical environments and an increasing ability to harness or to modify certain natural phenomena. The modern farmer in Saskatchewan shows an entirely different adjustment to the natural conditions from that of the Indians who preceded him, though no doubt the influence of the prairies is as marked on the social and economic life of the present inhabitants as on the culture of the Plains Indians, their former occupants. But time is on the side of man The cutting of the Suez and Panama canals, the irrigation works of California and S E Australia, are of the same order as the works of Nature which are said to be "controls", and these are but an earnest of still greater scientific achievements. The hot deserts may not only be made to blossom as the rose, but these areas of excessive insolation may also become the power stations of a new age when man has used up his capital energy of oil and coal Nevertheless, the main thesis holds true that world power, at present, is closely related to the ability of man to utilise the physiographic conditions of his region. A knowledge of the manner in which man to-day is adjusting himself to the modern complex conditions of world occupancy ranks high in the essential sciences. *Wissen ist Macht—Geographisches Wissen ist Weltmacht!*

The volume on North America furnishes not only innumerable illustrations of these principles, but also shows how these principles operate in the modern world. The first part traces the influence of physiographic conditions on the progress and development of settlement in America by emigrants from Europe The second indicates the conditions which have arisen in North America from the application of modern science to the utilisation of coal, oil, and iron, and to the cultivation of wheat and cotton, both groups being extractive industries which are essentially localised The third part reviews these historical and economic considerations from a geographical view-point, and discusses the present-day adjustment of life and labour which makes the geographic region a more powerful entity than the individual state Both the localisation of industries, as the iron and steel on the Pennsylvania coalfields, and the cultivation, and in these days the manufacture, of cotton on the warm fertile lands of the Atlantic and Gulf plains, give rise to regional interests of a very definite character Dr. Bowman states in his book, "The New World," in a section devoted to America: "To a much greater degree than an outsider might suppose, and in spite of all the patriotic assurances to the contrary, there is a deep underlying question in the minds of thoughtful men in the United States as to the continued unity of the nation." He reiterates the words of Prof Turner that to-day the United States is a federation of sections rather than of states, and that even a map of political votes roughly outlines the geographic provinces of the country.

Regional development is not, however, antagonistic to national unity. Indeed, it often furnishes the driving force of political or economic expansion. Most of the world-development problems of our time are questions of political or economic frontiers largely developed by expansive forces generated regionally within the political boundaries. Regional consciousness is expressed within the nation, national consciousness within the world itself. Though there may be, and often is, a physical and historical background, the delimitation of political divisions is often of an arbitrary character. Europe bears on its new political map the evidences of both the constructive and destructive forces let loose by the War. The pre-War tendency towards consolidation into great and powerful states has been followed by disintegration into innumerable new states, as Poland, Czechoslovakia, and Yugoslavia, the uprising of which can be explained, if not also justified, by considerations of a physical, racial, or economic character. As a statement of the new political position within the "peninsula" of Europe, together with a certain amount of useful data about each state, the volume on Europe serves as an excellent reference book. It is what it claims to be, a "compendium" rather than a geographical treatise. Such is the organisation of a modern state that, complex as may be the adjustment of life and labour to the physical conditions of the area, it forms a body politic capable of determining policies affecting not only its internal but also its external affairs. Political lines will sever what Nature has joined, often dividing physiographic or economic regions into two or more geographic entities, as between the United States and Canada or between France and Belgium On the other hand, political boundaries may bring a number of regional entities into a single political expression, as in the United States or France.

Though the political divisions may be somewhat arbitrary, the regional divisions within the state tend to be based on considerations of an economic character, which in turn may rest largely on physiographic foundations. The region has a distinctive life of its own, and the regional consciousness is more than the whirr of

its machinery or the rattle of its trains and lorries It springs from an adjustment of life and labour to the area, and it lives, not so much because of the factors which brought one or more of its industries into being, but because of its functions to-day A British company desirous of erecting additional cotton mills would place them in South Lancashire, not because of those factors which first attracted the industry, but because to-day the region possesses the machinery for dealing with the cotton trade, there are located the necessary subsidiary trades, and there is the great reservoir of labour skilled in the processes of cotton manufacture

South Lancashire to-day lives, no doubt, on cotton, but fate has not decreed that it must die if cotton be withheld, providing the withdrawal of the raw material is sufficiently gradual to allow a readjustment to new activities Man's salvation lies in his adaptability London, like some urban Vicar of Bray, has accommodated itself to and grown with the changing conditions of the British Isles, thereby retaining the premier position in trade and commerce If geographical science can so study what one may call the anatomy and functions of the region, diagnosing incipient diseases and prescribing cures, it will render invaluable aid not only to the body politic of which the region is a limb, but also to the millions of people whose lives are more or less anchored to the area Must New England necessarily perish because the Southern States have now entered into competition with it?

"North America" and "The New World" furnish innumerable illustrations of world development, both in the purely geographic region and in the political region, which in these days assumes a geographic form The former to-day conforms largely to an economic or physiographic foundation, because a region, like an individual, must in general live by work One example from "North America" must serve The broad indentation of the east American coast between Capes Cod and Hatteras appears on a relatively small scale map as an unnamed bay sweeping inward to the foothills of the Appalachians, broken in outline by three large inlets, Long Island Sound with the Narrows, and Delaware and Chesapeake Bays. These give access to river valleys which lead across the mountain barrier to the rapidly developing manufacturing and agricultural regions beyond Population in the narrow belt of broken lowland has gathered round the three port nodals of New York, Philadelphia, and Baltimore They and the surrounding districts form a region of considerable importance, though it is not easy to state exactly the causes of its growth The most powerful may well be the very size and adjustment of the present population, compelling the consideration of the factors of its origin to be made in the light of modern demands and opportunities What is said of New York, London, Berlin, and Paris may be applied to all great ports and their hinterlands "Every individual quota to provincial population, whether industrial or agricultural, has its counterpart in metropolitan expansion" Every development in the hinterland has a corresponding development in the port Yet Salem in New England and Chester in old England failed to keep the developing traffic of their hinterlands, and succumbed to Boston and Liverpool respectively. Great and prosperous cities have declined, and often the germ of decay has been secreted in the heyday of prosperity When geographical science can not only observe accurately the full foundations of regional prosperity, but can also form an estimate of the vitality and capabilities of the region, it will have made a contribution of prime importance to mankind.

The political region or state presents a geographical study of a somewhat different order The very rigidity of the frontier is incompatible with the economic development within and the expression of the national consciousness without "The New World" is an exhaustive and masterly study of problems in political geography They are problems of the frontier, either political, economic, or social Dr Bowman asks: "Will the changes in the political and economic geography of the world spell peace or war, strength or weakness, in the years immediately before us?" He then makes the comment that there are about 10,000 miles of boundary round the states of central Europe alone, of which more than 3000 represent newly located boundaries "Every additional mile of new boundary, each new location, has increased for a time the sources of possible trouble" Indeed, it may not be too much to say that the conflicts of expanding frontiers have probably been far more determinant of historical development than the physical conditions over which these frontiers have passed.

The principal cause of regional growth, accompanied by economic or political expansion, lies in the increasing ability of man to develop and utilise the world's resources. This ability is most evident in the large, well-organised states, and creates not only the desire but also the power to push outwards into the world market Economic or commercial geography throws considerable light on the character and direction of these movements, affecting not only the Great Powers of the world, but also the many states of Europe and Latin America The "Elementary Commercial Geography" is a useful introduction to this aspect of geographical study.

The effect of the frontier in American history has long been recognised But the expanding frontier did not rest on the shores of the Pacific States In

Alaska and the Aleutians, Central America and the Caribbean Sea, in Hawaii, the Philippines, and other Pacific Ocean islands, the United States has extended its political possessions, and this has been accompanied by a still greater expansion of its commerce and prestige in South America and the Far East Britain, France, Japan, and other nations differ from the United States not in kind, but merely in degree The consequence is that world development is being accompanied by conflicting interests over wider areas than the mere frontier zones of individual states Countries nominally independent, as China, and states under the administration of European powers, as those of Africa, are feeling the effects of world development Moreover, the change in the regional life is not measured merely by the change in economic values There is a profound change in the people themselves The old order changes, giving place to new. A new orientation and a new outlook are rapidly being developed. The population, under the external stimulus from Europe or America, is adjusting its life and labour anew to the physiographic conditions and possibilities of the region The African, the Egyptian, the Chinese, and a thousand other "questions" arising with world development have a regional basis, and demand the urgent and careful investigation of the new science of geography

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Some Sponges of the Southern Seas.

British Museum (Natural History), British Antarctic ("Terra Nova") Expedition, 1910 Natural History Report. Zoology. Vol. 6, No 3: *Porifera* Part 1 Non-Antarctic Sponges. By Prof. Arthur Dendy. Pp 269+392+15 plates. (London: British Museum (Natural History), 1924) 17*s* 6*d*.

PROF. DENDY has produced a very beautiful and elaborate memoir on the sponges collected by the *Terra Nova* expedition in the southern seas It is possible that such a highly technical piece of work may appeal only to a few readers at the present moment, but it can nevertheless be recognised as a permanent and important contribution to zoological science.

The modern developments of biology in the directions of embryology, the problems of heredity, experimental zoology, and comparative physiology have proved to be especially attractive to the younger generation of biologists, and no one can deny the value and importance of the scientific results of their work in the new fields of research that are being opened It must be remembered, however, that the accurate and detailed description of new and old species, especially when it is accompanied by sound judgment in systematics, and careful consideration of the possibilities of natural variation and powers of adaptation to environment, is an important and indeed fundamental branch of the science of zoology There is indeed a pressing need, at the present time; for more work of this description if we are to keep pace with the receipt of specimens that collectors are sending to Great Britain from all parts of the sea and land To workers in this line, Prof Dendy's account of the sponges may well serve as a model of what such monographs should be, and it is a great satisfaction to realise that some of our ablest zoologists are still willing to devote their time and expert knowledge to the production of systematic treatises of a high standard of merit.

All the sponges, except three, described in this memoir were obtained by five hauls of the dredge in water extending from the shallows to a depth of 100 fathoms off the north of New Zealand. The cruise revealed a very remarkable and, at the same time, a very rich fauna of sponges in these seas, such as has not yet been equalled in any region of the world In these five hauls no less than 90 species were discovered, and of these 62 appear to be new to science If it were to occur to any one on reading this statement in the introduction that in such a restricted area some of these species must be variations or mutations of relatively a few species, such a criticism would be dispelled by the careful description of the form and particularly of the spicules of the sponges the author describes

The problems associated with the occurrence of such a remarkable assembly of organisms of the same group competing fiercely with one another for the advantages of the situation are not ready for solution, but the record of this wonderful sponge fauna is of importance in the science of the distribution of animals, and should not be lost sight of or forgotten because it is buried in a systematic treatise

It is difficult to select from the many detailed descriptions of species the points of special interest for the general zoologist The extraordinary range in form and structure of sponge spicules and the numerous technical terms that have been invented for them may be bewildering to those who are not well acquainted with the literature of the group, but there seems to be no doubt that in the Porifera the spicules are more constant in character for each species, and therefore more valuable for systematic purposes, than they are in the Alcyonaria Accurate description and careful illustration of the spicules is an essential feature of a good monograph on sponges.

The discovery of two fine new species of the interesting group of hexactinellid sponges is a welcome and noteworthy point in this work.

The monograph is well illustrated by fifteen quarto plates, and we have to thank Prof. Dendy also for a good index.

The Rat Menace.

Rats and How to Destroy Them, dealing with Rats in a House, Shop, Warehouse, Outbuilding, Yard, Stable, Cow-house, Fowl-house, Pig-sty, Garden, Greenhouse, or Vinery, by a River, Stream, or Ornamental Water, on a Ship, Shooting Estate, or Farm; and in Sewers By Mark Hovell Pp. xlii+465. (London J Bale, Sons and Danielsson, Ltd, 1924) 10s 6d net

IT has been estimated that the damage caused by rats to the food supply and buildings in Great Britain alone represents a loss of something approaching 50 million pounds a year In addition to this, the rat is a serious menace to society as a carrier of disease, the occurrence of infectious jaundice in epidemic form on the western front during the War and more recently in Scotland, where a mortality of 40 per cent of cases occurred, has directed attention to a new danger near home, for which the rat is responsible It is common knowledge that rats are prolific, but few people realise the rapidity with which their numbers increase The litter in an adult rat varies from 8 to 16 Rats breed throughout the year, the period of gestation is only 21 days, and impregnation may again take place within a few hours of the birth of a litter

A very moderate estimate of the number of descendants of one pair of rats born during one year is well over a thousand, and these in the course of three years will have increased to a quarter of a million, these calculations are based on litters of 10, and only 6 litters in the course of a year are allowed for. A single pair of rats will eat more than 80 quartern loaves or their equivalent in a year, and their descendants in the same year will eat more than 46,000 loaves or their equivalent in wheat or flour

After reading the introductory chapter of Dr Hovell's book in which these and many other interesting facts are lucidly presented, one cannot remain apathetic to this ever-increasing menace to humanity The remainder of his book deals chiefly with all the known methods of preventing the spread of rats and destroying them in every conceivable situation Traps of every description are described, with many illustrations, and the relative values of all the better known forms of rat poison are dealt with A very interesting chapter is devoted to the history of bubonic plague, and the way in which it is carried by the various rat fleas It is interesting to note that, even in Old Testament times, rats were in some way held responsible for the spread of plague, continual reference being made to "golden mice" which were made "as an offering for the Plague"

There is a short section on rat cancer and the life history of the nematode (*Spiroptera neoplastica*) which causes this disease in the stomach of the rat and passes its larval stages in the muscles of a species of cockroach In this and in his remarks as to the possible relation of human cancer to cockroaches, the author is perhaps a little misleading, as he does not state that the cockroach in question is the New World cockroach *Periplaneta americana*, and not *Blatta orientalis*, which is the one common in Europe

There is an appendix dealing with a scheme for the organised destruction of rats throughout the country, but though this would seem to be a highly desirable step, it would require special legislation to enforce

The book is one which will direct public attention to a very real menace and at the same time be of the greatest assistance to those who are brought into direct conflict with that menace

Our Bookshelf.

Masters of Science and Invention By Floyd L Darrow Pp v+350+24 plates (London · Chapman and Hall, Ltd, n d) 10s 6d net

IN recent years progressive science teachers have been pondering the problem of "humanising" scientific instruction, of introducing the breath of life into the "valley of dry bones" of experiment, observation, and inference, and thus in a measure treading on the ground hitherto monopolised by the humanists The work under notice represents an attempt in this direction The author has set himself the difficult task of giving, in simple biographical form, an account of the development of scientific achievement, and he states that "no knowledge of the laws of science and their manifold applications is even approximately complete without acquaintance with the outstanding figures who have made possible the age in which we live" In the twenty-eight chapters, each of which is more or less complete in itself, we are given an excellent bird's-eye view of the march of discovery and invention, which will especially appeal to the young—in years or knowledge

Although we may question if biography is essential to the understanding of the content and method of science, there can be no doubt that its inclusion is a most valuable stimulus, particularly to that large majority which prefers the study of man to the study of Nature This book is a very useful addition to popular scientific literature, the arrangement is good, the style is clear and vivid (but why, oh why, does the author never use a colon or a semicolon ?), the selection of "masters"—an invidious task—is good, and the statements are generally accurate Two errors in the chapter devoted to briefer biographies should be corrected Sir Ernest Rutherford is no longer professor of physics at Montreal, and the late Sir William Crookes was never a professor either in the Royal College of Science, Oxford, or elsewhere.

An analysis of the nationalities of the men who are noted at length in this volume may be of interest Of the men of science, about one-third are British, one-fifth French, one-sixth German, one-fifteenth each

American (U S.A), Swedish, and Swiss , whilst ninety per cent of the inventors are either American or British If these figures may be taken as a rough index of the distribution of scientific and inventive genius, it would appear that although science has no fatherland (as Pasteur said), invention can make out a good claim for the English-speaking world

Complex Salts By Dr William Thomas (Manuals of Pure and Applied Chemistry) Pp. xi + 122 (London, Glasgow and Bombay Blackie and Son, Ltd , 1924) 10*s* net

Dr Thomas's book on "Complex Salts" is a small volume of about 120 pages, intended more especially for students reading for final and honours degrees It differs from a recent book by Schwarz on "The Chemistry of the Inorganic Complex Compounds" (see Nature, October 27, 1923, p 617) in that it deals in a much more general manner with the problems of molecular asymmetry, optical activity, methods of resolution and rotatory dispersion of optically-active complex salts On these subjects Dr Thomas has himself done important original work

A novel and extremely valuable feature of the text is a chapter on the "Preparation and Resolution of Inorganic Complex Salts," including two examples of resolution, one involving the use of an active acid, and the other the use of an active base This chapter should be of great value in enabling an honours student, or a young research worker, to secure experience in the manipulation of this important group of compounds The book is presented in an attractive form, but the price appears to the reviewer to be rather high in view of the small size of the volume, although the price per page is appreciably less than that charged for the English translation of Schwarz's book

The equilibrium-diagram which represents the case in which a racemate is formed when the temperature is raised, instead of (as in the case of sodium ammonium tartrate) when the temperature is lowered, appears to have been omitted, since Fig 3, p 60, represents the unsymmetrical diagram for a double salt which decomposes above a transition-point It is not immediately obvious from the text what has gone wrong, and a student who encountered this error without knowing the correct form of the diagram might be puzzled for a long time before finding the correct interpretation

The High Grass Trail: being the Difficulties and Diversions of Two; Trekking, and Shooting for Sustenance in dense Bush across British Central Africa By Frank Savile. Pp. 255 + 10 plates (London H. F. and G Witherby, 1924) 15*s*. net

This is a day-to-day account, written in an easy and pleasant style, of a shooting trip, undertaken in the high grass season, to Nyasaland and Northern Rhodesia As no map has been provided, and most of the places mentioned are not marked on the ordinary map one has at hand, it is not easy to follow, except in a general way, where the author really did go

This part of the world seems to be a veritable sportsman's paradise, both as regards small and big game There was something to shoot almost every day The natives are extremely friendly and willing to assist in all operations of shikar Their intense desire for meat makes them very ready helpers where big game is concerned. In a country where supplies are so scarce it is necessary to ply the gun in order to keep the larder replenished, and provide food for an army of carriers. Some game, however, is not exactly up to the white man's standard Of zebra meat the author remarks: "It is dark, unwholesome red, greasy and revolting. I have tried the brains and tongue, which are passable, but so far, to Allah be praise, have never had to set my cheap German teeth the task of masticating its steaks or cutlets," but "the ordinary nig loves it"

None of the problems of the country are dealt with. It is purely a book for the sportsman, and any one contemplating a visit to British Central Africa for shikar purposes should certainly read it It will give him a good idea of what to expect as well as a considerable amount of entertainment H L C

Chambers's Encyclopædia: a Dictionary of Universal Knowledge New edition Edited by Dr David Patrick and William Geddie Vol 4: Dioptrics to Freistadtl Pp iv + 856 Vol 5: Fréjus to Humboldtia Pp iv + 840 (London and Edinburgh: W and R Chambers, Ltd , Philadelphia: J B Lippincott Co , 1924) 20*s* net each vol

The most recent volumes which have appeared of this handy encyclopædia carry the alphabet nearly to the end of the letter H They are well supplied with finely produced coloured maps, of which the historical maps of Europe and the physical and geological maps of Great Britain are particularly useful Most of the articles of the last edition have undergone revision, in some cases by the original writers, and references to recent events have been added Other articles have been re-written. Many of them are models of summarised knowledge, and several on the more important subjects run to considerable length Thus "electricity" covers twenty-six pages, with another eight pages on cognate subjects. "Eye" runs to twelve and "fishes" to seven pages. Cross-references enhance the value of the work, but do not occur so frequently as to impede quick reference

Elementary Experimental Statics for Schools Written by A P McMullen. Revised for the Press, with some additional Matter and a Preface, by E W. E. Kempson Pp vii + 315 (Cambridge: At the University Press, 1924) 8*s* 6*d*

If the object in teaching a subject such as statics to schoolboys is not so much to give them anything in the nature of a logical training as to render them appreciative of the fundamental principles and convinced of their truth, no better system can be adopted, we believe, than the experimental method Especially is this the case in the present age, when boys display a lively interest and knowledge of machines, and appear to have relatively little difficulty in grasping the idea of mechanical work It is for this reason that the authors of the present book have developed their subject in the order work, moments, triangle of forces, dealing in their appropriate places with friction, centres of gravity, equilibrium and stability The result is that they have produced a book which must be of real value to all teachers of the subject The illustrations are copious and instructive.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Local Reflection of Wireless Waves from the Upper Atmosphere.

IN some recent experiments carried out for the Radio Research Board of the Department of Scientific and Industrial Research, measurements have been made of the diurnal variation of the signals received at Cambridge from the stations of the British Broadcasting Company. During the day-time these signals have been found to be fairly constant, but night-time variations of intensity have been measured at distances from the transmitter so short as 50 miles. For example, the signals from London at Cambridge are found to be constant during the day; but, at about sunset, variations, which are often of a periodic character, begin, and continue through the dark hours. In this case the mean night value is very little different from the day value. For more distant stations (for example, Bournemouth) the phenomena are different. During the day the signal is weak and constant; but after sunset the intensity increases and, though variable, the signal maxima may be several times the day value. In this case the variations in signal intensity are larger, less rapid, and less markedly periodic than in the case of the London signals.

These effects may be explained in a general way if an atmospheric reflecting layer is postulated which is comparatively ineffective for the waves of this frequency during the day-time but bends them down very markedly at night. According to this view two rays arrive at the receiver at night, one nearly along the ground, which may be called the direct ray, and the other returned from the atmosphere, and called the indirect ray. In the case of the London signals the direct ray is considered as being strong and constant compared with the indirect ray; and the night-time variation is considered as being due to interference between the direct and the weak indirect ray. For the longer distance transmission, the stronger night-time signal is to be attributed to the indirect ray.

If the reflecting stratum is imagined to be at a height greater than say 50 kilometres, the above interpretation indicates bending back at relatively small angles of incidence (for example, if London is considered, and the height is assumed to be 100 kilometres, this angle of incidence is about 22°). Such high grazing angle reflection from the Heaviside layer has not usually been considered possible, and we have therefore attempted to examine the phenomena in a more direct manner. The method adopted has been to vary the frequency of the transmitter *continuously* through a small range and attempt to detect the interference phenomena so produced between the two rays. From our measurements it was estimated that at a distance of about 160 kilometres from the transmitter, the effects of the direct ray and the indirect ray at night would be approximately equal.

The British Broadcasting Company, on being approached, very kindly consented to collaborate in the experiments and to use the Bournemouth station as the transmitter. Oxford, being about 140 kilometres from Bournemouth, was chosen as the receiving site, and excellent facilities for the installation of the receiving station were provided for us in the Oxford Electrical Laboratory by Prof. J. S. Townsend and Mr. E. W. B. Gill. Capt. A. G. D. West, of the B.B.C., who was in charge of the Bournemouth end of the experiment, arranged the transmitter so that a known frequency change could be produced uniformly during a given time (for example, 10 to 30 seconds) while the aerial current remained practically constant. The received signal intensity at Oxford was determined with a receiver specially designed to give approximately uniform sensitivity over this band of frequencies. The resulting signal currents were measured by moving coil and small Einthoven galvanometers. Mr. F. G. G. Davey gave us most valuable assistance at the receiving station. Land-line communication was also maintained between the two stations during the period of the experiments for control purposes.

Two sets of experiments were carried out on December 11, 1924, and on February 17, 1925, and in both cases quite definite examples of successions of interference bands were observed as the wave-length was changed, the intensity varying from a maximum value almost to zero as was arranged for by choice of distance. If we assume the simplest interpretation of these interference phenomena and regard them as analogous to those of a Lloyd's mirror fringe system, the effects may be viewed as follows. For a direct ray path of length a, a higher ray path of length a' and a given wave-length λ, the higher ray arrives N wave-lengths behindhand as compared with the lower ray where $N=(a'-a)/\lambda$. If N is an integer the waves steadily reinforce unless a' is changing, while if N is halfway between two integers they are steadily opposite in phase. If the wave-length is gradually increased to λ' at the sending station, alternations of intensity may be expected, the number being $(a'-a)/\lambda-(a'-a)/\lambda'$. The experimental observations according to this simple interpretation indicate a path difference $(a'-a)$ of the order of 80 kilometres, which is consistent with a reflecting layer at a height of about 85 kilometres. Evidence was, however, obtained that the results may be somewhat complicated by the elliptical polarisation of the indirect ray, in which case the above estimate of the height may have to be revised. Further experiments on this point are in progress. But the interference phenomena between two rays depending on the existence of a deflecting layer seem definitely established.

It has been usual to attribute the difference between day and night strengths of wireless signals to a difference in the sharpness of the boundary of the effective atmospheric layer, the lower boundary being assumed sharper by night than by day. We think, however, that the transition cannot be sharp compared with the wave-length, particularly for the short waves we have used, and therefore the term "reflection," used for convenience above, must be taken as meaning "ionic deflection."

We imagine, therefore, that at night the layer is sufficiently high and intense to permit of ionic deviation taking place, the ray being turned through large angles without undue absorption. During the day the ionisation due to solar agencies throws the ray down at lower levels (for example, 40-50 kilometres), and here, although ionic refraction can take place, the collisional "friction" causes heavy absorption at these short wave-lengths and high grazing angles. The difference in the action of the atmospheric ionisation between day and night is therefore to be taken as due to the differences in height (and therefore density) of the effective layer, and not as due to the difference in the sharpness of the boundary of the layer as has been usually assumed.

These and other experiments suggest the inference that, at distances greater than about 100 miles from a wireless transmitter of these wave-lengths (for

example, 300-400 metres), night-time reception is dependent almost entirely on the upper indirect ray, and evidence is not lacking that, due to the more effective reflection by the ionised layer at smaller grazing angles, the signal strength maximum may in some cases increase with increase of distance from the transmitter

E V APPLETON
M. A F BARNETT

Cambridge,
February 21

The Propagation of Radio Waves over the Earth.

AMONG the facts to be explained in a satisfactory theory of the propagation of radio waves over the earth's surface are the curvature of the rays in transmission between stations far apart, the absorption during transmission, the peculiar phenomenon of fading, in which the magnitude of the received wave fluctuates more or less rapidly, the differences in transmission in different directions over the earth, and the extraordinary differences in the transmission of long and short waves

This letter is to outline a new theory of transmission which accounts quantitatively for many previously unexplained facts of radio transmission A detailed treatment of important cases will appear shortly

The atmosphere to a considerable height above the earth contains ions which react upon electromagnetic waves and, as shown by Larmor (*Phil Mag*, Dec 1924), may account for the bending of long waves around the earth His explanation, however, does not show the large and characteristic differences between short and long wave transmission, which become especially marked in passing through the region between 100 and 200 metres Other theories, also, have the defect of predicting entirely incorrect results for short wave-lengths

The theory now developed takes into account both the earth's magnetic field and the distribution of ionised particles in the atmosphere It is found that this field, together with the electrons, produces marked selective effects at wave-lengths between 100 and 200 metres, and that these effects are different for different directions of transmission and for different planes of polarisation of the wave A summary of the effects follows

For the case in which the electric force of the wave is parallel to the earth's magnetic field, the only effect is due to a variation in ionic density above the earth This case is realised practically only over very limited areas of the earth's surface

For transmission in any other direction or for any other direction of the electric field, four effects are in general produced, namely, the plane of polarisation of the wave is rotated by an amount depending upon the density of free electrons, the magnetic field, and the frequency This effect reverses at the critical frequency, which, for a field of 0·5 gauss, is 1400 kilocycles (214 metres) The second effect is that of double refraction in the medium, producing two waves of different velocities and polarisations The third effect is a bending of the rays due to a variation in ionic concentration, as in Larmor's case, but, due to the magnetic field, this bending also, in most cases, reverses at the critical frequency, so that if long waves bend down in a certain region, short waves will be deflected upwards in the same region. The fourth effect is a bending of the rays due to variations in the magnetic field strength, and this effect also reverses at the critical frequency

The general solution of this problem cannot be given in this note, but some interesting special cases will be described

For transmission from a vertical antenna along a magnetic meridian the electric vector tends to be rotated, and, when this rotation becomes equal to 90°, the usual methods of reception produce no signals, hence we should expect, in general, better reception of east-west than of north-south signals at certain points Also, since the plane polarised ray can be resolved into two circularly polarised rays travelling with different velocities, under certain conditions both components may not be able to travel over the same path between two points

The rotation of the plane of polarisation for transmission along the magnetic field is rather large, for example, the electric vector in a wave 2 km long will turn from vertical to horizontal in about 80 wave-lengths if there are present only 10 free electrons per cubic centimetre in a layer for which the mean free path is sufficiently long for free motion A wave 100 metres long will rotate through the same angle, but in the opposite direction, in about 5000 wave-lengths or 500 km For larger ionic densities, appropriate to high levels, the waves may be rotated very rapidly, which is one of the causes of variable transmission along a magnetic meridian

For transmission at right angles to the magnetic field, we find double refractions with the ordinary ray unaffected by the magnetic field and the other selectively affected

In all these cases, the variation in the number of ions and in the magnetic field at different heights above the earth produces deflexions of the rays which may be calculated

The introduction of a resistance term into the equations of motion of the electron leads to an attenuation factor in the equations of wave-motion Thus, for transmission parallel to the magnetic field, the exponential term involves the reciprocal of the square of the frequency for frequencies sufficiently large compared to the critical value. This means, therefore, that attenuation due to this cause falls off rapidly as the frequency is increased At the other extreme the same expression is found to apply, except that in place of the transmitted frequency, the critical value is substituted Hence in this range attenuation due to this cause is constant There are, of course, other causes of attenuation—for example, the conductivity of the earth

When the frequency is near the critical value, large anomalous effects occur For example, the wave may be required to travel over a widely different path by a slight change in either the magnetic field or the ion density The signal may arrive at the receiver from several directions simultaneously or successively, producing fading or apparent change of direction The absorption may become extremely high for certain rays

The detailed theory, with its predictions, will be published soon

H W NICHOLS
J C SCHELLENG

Bell Telephone Laboratories, Inc,
New York City,
February 6.

Molecular Symmetry in Crystal Structure.

IT has been pointed out by Clark[1] that there is a great similarity between the structures of the four alkali polyhalides KI_3, CsI_3, $CsIBr_2$, and $CsICl_2$. They have the same arrangement of atoms in unit parallelepipeda, if the unit cells are chosen so as to contain one molecule The arrangement is with the metal atoms at the corners of the cell and the halogen atoms inside the cell and in a line on the body diagonal.

[1] A L Clark, Pro Nat Acad Sci, 9, 4, 1923, p 112.

The same arrangement is taken up by the complex radicles in the hexammoniates of the nickel halides and the hexahydrate of zinc bromate This body-centred grouping is a deformation of the arrangement in CsCl [2]

A study of the chlorates, bromates, and iodates of sodium and potassium shows that similar relations exist between these salts Some are closely related to cæsium chloride in structure, which we shall call the CsCl set, and the rest to sodium chloride, referred to below as the NaCl set The distinction between the more complex salts and the simple halides is that in the former the chemical molecule can be identified, in the latter it cannot

Sodium chlorate and sodium bromate have been studied by several workers [3] They belong to the NaCl set, with four molecules per unit cell, the edge of the half-molecule parallelepipedon being 3 29 angstroms in the chlorate and 3 35 angstroms in the bromate

The three potassium salts have been examined by the writer using the ionisation spectrometer, and the following results were obtained

Potassium chlorate, which is monoclinic, belongs to the NaCl set The half-molecule parallelepipedon has edges 3 56, 3 69, 3 69 angstroms Potassium bromate is ditrigonal pyramidal (pseudocubic) Measurements on the spectrometer show it belongs to the CsCl set, the edge of the one molecule pseudocube being 4 46 angstroms Potassium iodate is monoclinic (pseudocubic) The spectrometer method, and a photograph taken by the powder method, show that it belongs to the CsCl set The edges of the one molecule parallelepipedon are 4 57, 4·50, and 4 50 angstroms

No measurements have been made on anhydrous sodium iodate, but, from its form and specific gravity, it probably belongs to the CsCl set

The great similarity between these more complex salts and the simple halides shows that the complex radicles act as single units and the molecule behaves as an electric doublet Each radicle is surrounded, but not equidistantly, by six or eight oppositely charged radicles according as the crystal is of the NaCl or CsCl type The question arises as to the possibility of determining the positions of the constituent atoms of the complex radicles, from symmetry conditions and intensity measurements

The case of cæsium dichloro-iodide, examined very completely by Wyckoff,[4] indicates that this determination is impossible from symmetry considerations, and he attempts to fix the chlorine atoms from his intensity measurements alone, describing his results as very uncertain on this account Symmetry considerations, following Shearer's principle,[5] show that the $CsICl_2$ molecule should possess a trigonal axis, which is impossible for any static arrangement of the ICl_2 radicle, since chemical considerations of stability, and the shape of the cell, negative the placing of the atoms in a line along the trigonal axis

Another relevant case is that of the ammonium radicle in ammonium chloride The radicle as a whole occupies positions in space which determine the crystal symmetry, and the positions of the hydrogen atoms cannot be determined This conclusion is verified by the study of the ammonium alums

There seems to be no valid reason for giving to the hydrogen atom alone the negative privilege of self-effacement in symmetry considerations, so long as it occupies space The fact that the salts containing complex radicles which are considered above are so closely related to the simple halides leads to the conclusion that, for other radicles as well as ammonium, the symmetry is independent of the position of the constituent atoms in the radicle, the latter behaving as a unit The crystal-forming forces are probably electrostatic attractions independent of any structural axes the radicles may possess

The occurrence of what has been called ionisation in the simple halides has led to the conclusion that no deduction as to atomic symmetry can be made from their crystal structure As I have pointed out elsewhere,[6] this "ionisation" probably indicates the presence of heat motion in the form of rotation In the simple halides the radicles can rotate separately, since there is no molecular bond In the more complex salts considered above, in which the chemical molecule exists, the molecule apparently rotates as a whole about the electrostatic axis of the doublet, and the positions of neighbouring molecules are probably determined by the sizes of the radicles and pressure considerations, similar to those described by Bartlett and Langmuir,[7] to explain the transition of ammonium chloride from the CsCl to NaCl type

J H SMITH
Physical Laboratory, University College,
London, January 29

[2] R A Dickinson, J A C S, 44, 1922, p 1489.
[3] A Karssen Dissertation, Amsterdam, 1923, W Kiby, *Zeit f Physik*, 17, 1923, p 213
[4] R G W Wyckoff, J A C S, 42, 1920, p 1100
[5] G Shearer, Pro Phys Soc Lond, 35, 1923, 81
[6] J H Smith, *Science Progress*, Jan 1924, p 403
[7] Bartlett and Langmuir, J A C S, 43, 1921, p 84

The Atomic Weights of Zirconium and Hafnium.

IT is just a hundred years ago that the atomic weight of zirconium was determined by Berzelius The method used, namely the analysis of the sulphate, yielded too low a value for the atomic weight, the same being the case in all the different methods used by his followers This error was compensated, however, in part by the presence of 0 5 to 2 per cent of a heavy element (hafnium) in their preparations (see NATURE, March 15, 1924) It was only in 1917 that Venable and Bell, when analysing $ZrCl_4$, used a more trustworthy method originating from T W Richards's laboratory The values found by these investigators were appreciably higher than those found by their predecessors, and showed at the same time fluctuations for the values of the atomic weight, greater than should be expected considering the extreme precautions taken and the reliability of the method used.

These fluctuations could not be accounted for at the time of the measurements After the discovery of hafnium it suggested itself that the variations found by Venable and Bell were due to a varying hafnium content in the preparations used Through the courtesy of Prof Venable we have been able to investigate the samples used by him and by Dr Bell, and have found a hafnium content varying between 0 7 and somewhat above 1 per cent Taking into account this presence of an element having the atomic weight of about 180 in their preparations, Venable and Bell calculated the value 91·3 for the atomic weight of zirconium This value is in an excellent agreement with the value (91 25) arrived at recently by Honigschmid and Zintl (*Zeit anorg Chem* 139, 293, 1924) using a preparation purified from hafnium in this laboratory and found to contain less than 0 02 per cent. of this element It is of great interest that the above numbers coincide cosely with the value which can be estimated from experiments with positive rays Aston found for zirconium the mass lines 90, 92, 94, and a doubtful one at 96, and estimates the atomic weight as 91 4 or 91 2, according to whether the mass number 96 is included as an isotope or not We may, therefore, be justified in believing that the atomic

weight of zirconium is 91·3 with an accuracy of about 0·1 unit

While the presence of 1 per cent HfO_2 in a preparation of ZrO_2 influences the apparent atomic weight by 0 6 unit, the presence of 1 per cent of ZrO_2 lowers the apparent atomic weight of hafnium by not less than 1 4 units One must thus obtain a hafnium preparation containing a very small amount of zirconium in order to fix the atomic weight of hafnium with an accuracy similar to that reached for zirconium It was possible some time ago to supply Prof Honigschmid with such preparations from this laboratory The values found by him, when analysing $HfBr_4$, for the best preparation were 178 32 and 178·35, and for a less pure fraction 177 78 and 177 80 The samples used by Honigschmid and Zintl were recently very thoroughly investigated by Mr Thal Jantzen by means of the method of X-ray analysis, which when proper precautions are taken is able to give values of high accuracy and offers a simple method of estimating the zirconium content of hafnium preparations The values for the zirconium content of these preparations were found to be 0 16 and 0 57 per cent The values for the atomic weight found by Honigschmid and Zintl have thus to be raised to 178 57 in the first, to 178 64 in the second case, and we may, therefore, with a probable error of less than 0 1 unit fix the atomic weight of hafnium at 178 6

G HEVESY

Universitetets Institut for teoretisk Fysik,
Copenhagen, February 5.

Late Palæolithic Art in the Cresswell Caves.

I WRITE as chairman of the British Association Committee, now resuming, by permission of the Duke of Portland, the exploration of the Cresswell Caves where it was dropped some forty years ago by the Rev Magens Mello and myself, to prevent your readers from being misled by the following passage in the third edition of Prof Sollas's book on "Ancient Hunters," p 536

"There is a singular absence of any attempt at art in all the Palæolithic stations of England The horse figured here [Fig 299] is, I am assured, a forgery introduced into the cave by a mischievous person"

The Cresswell horse was the first proof of the range into Britain of the wonderful art of the French caves, and the discovery made in the 'seventies by myself was published—after a careful scrutiny by Sir John Evans, Sir Augustus Franks, Lord Avebury, General Pitt-Rivers, and other leaders—in the Quarterly Journal of the Geological Society of London It has remained unchallenged for more than forty years, and has passed into the literature of anthropology *Res judicata est* The charge of forgery is not now to be made without clear evidence In answer to a letter asking for this evidence Prof Sollas writes to me that it is based on what he was told "some years ago, I think 1919," by a clergyman since dead, who declined to give names or other particulars This means that the charge of forgery is founded on gossip without a shred of evidence, and is unworthy of further notice

The Cresswell horse is engraved in fine lines in a style similar to that of the figures of animals found since in the late palæolithic caves of France and Switzerland It is not accurately represented by Prof. Sollas in his Fig 299 This figure is copied from Evans's "Ancient Stone Implements" (2nd edition, p 524), in which my woodcuts were used If the copy be compared with the original it will be seen that the details have been omitted, leaving merely an outline useless for the study of the art of the caves

Prof Sollas is equally unfortunate in his sweeping statement that there is no attempt at art in the palæolithic caves of England Our Committee is now at work at Cresswell, and Messrs Garfitt and Leslie Armstrong have already recorded the discovery of incised figures of bison and reindeer along with other late palæolithic finds As the work proceeds it will probably result in further proof that the picturesque gorge of Cresswell Crags was a hunting station of the artistic tribes who followed the wild animals in their migrations from the south of France into Britain, then the north-western region of the great Pleistocene Continent

W BOYD DAWKINS

Fallowfield House,
Fallowfield, Manchester,
January 29

The Ages of Peat Deposits.

THE wide interest now taken in the study of peat will, I think, justify further reference to the subject of Dr Pearsall's article in NATURE of December 6 and the letters from Mr Tonks and Mr Forbes which followed on January 24 It is satisfactory to note that Dr Pearsall has withdrawn from the obviously fallacious correlation he at first put forward He now, however, makes a second correlation based on the identification of the birch scrub on the peat-covered 25-foot beaches as Lewis's Upper Forest, making the latter Neolithic in age and therefore climatically in conflict with the evidence in the Pennines This yields him the same result, namely, that climatic deductions from peat and forest beds are untrustworthy

This second correlation, however, has no more to recommend it than the first Mr Forbes will, I am sure, bear me out when I say that a few isolated occurrences of birch scrub at a low level are no proof of a forest period On the contrary, the evidence of the submerged forests indicates that the period of greatest tree growth in the British Isles, *i e* Lewis's Upper Forest, antedates the 25-foot beach Dr Pearsall will, therefore, have to try still another correlation if he wishes to establish his point

May I add to that of Mr Tonks my appreciation of the admirable work recently done in the Pennines by Dr Woodhead, Mr Buckley, and Mr Holmes

W. B WRIGHT

Manchester.

IN directing further attention to the question of peat deposits, Mr Wright seems to add little to the questions raised He accuses me, however, of basing a hypothesis on the occurrence of isolated patches of birch scrub I have repeatedly (and publicly) expressed the opinion that the presence of timber in peat can have little significance unless the wood layer is continuous over a very wide area, and I have, indeed, criticised Lewis on the grounds that his "forest layers" did not always fulfil this condition. I may, therefore, be forgiven for finding Mr Wright's accusation a little amusing It appears to me, however, that his criticisms can only be seriously urged by disregarding completely the use of the words "may" and "might" in my letter (although one of them is italicised), and by failing to attach any significance to the sentence which expresses the opinion that, on whatever they are based, these hypothetical correlations throw doubt on the climatic hypothesis of peat stratification This is the gist of the letter, to which Mr Wright's attention may be redirected

W H PEARSALL.

The University, Leeds

The Mortality of Plaice.

THE letter of Dr G P Bidder in NATURE for January 31, p 155, on "Constant Differential Growth-ratios and their Significance," raises the very interesting question Are plaice potentially immortal? In other words, does senile decay occur? This might be decided directly by cytological investigation of old fish; but there is another indirect aspect of the question which my own work on plaice suggests as worthy of being brought forward in this connexion, namely, the differential death-rate of the sexes Dealing with large collections from two regions, the North Sea and western part of the English Channel respectively, I showed (International Investigations Marine Biological Association, Report III. 1906–8 (1911)) that in each region males were more numerous than females up to the age at which the majority of males become mature for the first time, after which, or soon after which, females begin to preponderate, the number of males diminishing somewhat rapidly

Commenting on this phenomenon I said "The reason for the *rapid* decline in the relative number of males just after maturity might be somewhat obscure if only natural causes were at work We know, however, that in the breeding season the catch of ripe males by trawlers greatly exceeds that of females on the spawning grounds, and it is possible, as Hefford suggests, that this factor may be the cause of the rapid decline in the proportionate numbers of this sex after maturity is reached" This artificial factor would, however, scarcely explain the whole result, nor would it account for the same phenomenon in the plaice of the Barents Sea, which was practically a virgin fishing-ground when Atkinson investigated it in 1907 and 1908 (Journal of the Marine Biological Association, vol 8, Nos 2 and 5) Then there are many cases of other species of fish and of other groups (cited by S W Geiser, *American Midland Naturalist*, vol 8, No 7, 1923) in which the same thing occurs, and where there is apparently no suspicion of the unequal incidence in the two sexes of extraneous factors tending to the longer survival of one sex How then are we to account for the difference except by the lesser viability of males? This apparently implies natural death

Dr Bidder also makes the interesting statement that "the ratio of ovary-weight to body-weight has no relation to age, but only to body-weight; in this as in some other respects, the age of a plaice is not measured by years but by the quantity of food which it has succeeded in assimilating" Among the "other respects" with which I am familiar from personal investigation I may mention the advent of maturity, which is apparently determined by size and not by age Thus the plaice of the Barents Sea (see Atkinson, *ibid*) are the same average *size* at first-maturity as the plaice of the central North Sea, but the average *age* at first-maturity differs very considerably owing to the much slower growth-rate of the Barents Sea fish (up to 1908 at least), due ostensibly to overcrowding and limited food supply The same general cause would also account for the fact that while the average *size* at first-maturity of the North Sea plaice soon after the War (during the latter years of which restrictions on fishing produced overcrowding) was the same as in pre-War years, the average *age* at first-maturity was considerably higher

WILLIAM WALLACE

Fisheries Laboratory,
Lowestoft,
February 11

Coal Resources of Alberta.

I SHOULD like to use the medium of your pages to ask that, when scientists and others sit in their offices or studies at home, to write about the resources of the outlying portions of the British Empire, they at least consult up-to-date and official reports on their subject I hesitate even to suggest that they might restrain their pens either from modesty or from fear of ridicule when their information is only second-hand

A case in point is a recent volume on "Fuel" in the "Resources of the Empire" series The description of the coals of Alberta, which have been estimated to constitute more than 60 per cent of the coal resources of the British Empire, is allowed only one and one-half pages out of the 63 pages in this section of the book The compiler takes most of his statements from a report published in 1913, and now much out-of-date But, to make matters worse, in a drastic condensation of the earlier report, he retains all or most of the mistakes and adds others The result is laughable to any one who knows anything of the subject

The Canadian Government at Ottawa has published many reports on the natural resources of the country, and the Scientific and Industrial Research Council of Alberta, during the past five years, has published ten reports on the resources of the province These reports are readily available in England, and requests for information receive attention There is therefore no excuse for the publication in England of out-of-date and incorrect statements

EDGAR STANSFIELD,
Honorary Secretary,
Scientific and Industrial
Research Council of Alberta

Edmonton, January 30

Pliocene and Pleistocene.

As you quote in NATURE of February 21, p 278, from a note of mine printed in No 6 of *Natural History* (American Museum of Natural History), will you allow me to state that the note quoted was not submitted to me in proof by the editor of *Natural History* The part you quote embodies a serious misprint The words "distinguished by the marine 'Pliocene'" should read "distinguished by the name 'Pliocene'" As I am writing further on the application of the terms "Pliocene" and "Pleistocene" to various deposits in East Anglia, I should like to remove at once this unfortunate misrepresentation of my views.

E RAY LANKESTER

Mercury Helide.

IN a recent note (NATURE, December 13, 1924, p 861), dealing with the formation of mercury helide, mention was made of a plan which was being perfected for a quantitative analysis of the compound. The analysis has now been completed, with the result that 210 79 parts by weight of mercury were found in combination with 4 18 parts by weight of helium. Hence 200 6 parts by weight of mercury combine with 3 98 parts by weight of helium The simplest formula for the helide is therefore HgHe.

A detailed account of the work upon which this conclusion is based, will, I hope, be published shortly.

J J. MANLEY.

Daubeny Laboratory,
Magdalen College, Oxford,
February 13

The Control of the Tsetse Fly Menace.

By C. F M. SWYNNERTON
(in charge of Tsetse work in Tanganyika Territory)

TSETSE-FLY problems may be divided into three —the problem of *G. palpalis* and the rain-forest tsetses, that of *G tachinoides* and that of the savannah or "bush" tsetses belonging to the *morsitans* and *fusca* groups These, as Major Church showed well in his recent article in NATURE, January 31, inhibit the development of vast areas in Africa, and members of the *morsitans* group are the carriers of Rhodesian sleeping sickness. It is to the control of the bush tsetses that I shall refer in this article (though the broader principles laid down would refer to all), and I shall describe in particular the methods and ideas that we are employing in our fight against them in Tanganyika These may be understood best if I say that I have from the first felt that if we are to attack the tsetse-fly economically as well as effectively, we must do so in the main by the mere diversion and regulation of agencies already in existence—always, of course, with the fullest knowledge of and regard to the habits of the particular species we are fighting.

This implies that the natives would be taught to understand and take part in the solution of their own problems, and that natural agencies, such as grass-fires, flooding and exceptional seasons, would be harnessed In a report to the Portuguese Government (*Bull Ent Res*, vol. xi. pt. iv. pp. 315-385) I laid special stress on the fact that "settlement properly planned will protect itself," on the utility of offering inducements to natives to settle in places, perhaps quite limited, where previous ecological investigation should have indicated that their presence will lead to control of the fly, on the part that European settlement on a sound agricultural basis might be made to play if clearing of the crucial spots were made a condition of occupation and the farms were small enough, and on the probable great value of postponing the annual grass-burning, usually worse than useless, to the end of the dry season (October), and then carrying it out under chosen conditions and in a thoroughly organised fashion [1] I also emphasised the necessity for studying means of consolidating clearing or, in the absence of consolidation, the need, in a great fly-belt, for providing fly-proof barriers up to which to work; and, in a later report (*Bull Ent Res*, vol xiii, pt iii pp. 317-370), I sketched the scheme which has since been put into operation in Tanganyika Territory, and will be described briefly here [2]

It should be noted, first, as regards "settlement properly planned," that the bushless cattle-areas of that Territory are, in very large part, "culture steppe," to borrow, provisionally, a German term That is, they are kept free of bush and, thereby, of tsetse-fly, almost solely through the presence of sufficiently (not excessively) closely-dotted villages with their chopping for firewood, building and cultivation and the browsing of their numerous stock On the whole, settlement and bush, man and fly, are sharply segregated It is hoped that by encouraging this form of settlement in the far greater areas in which the natives *all* live dotted through the bush, pestered with tsetse and subject to other serious disabilities, we shall extend segregation and obtain what will be, for practical purposes, a control of the fly. This form of settlement—implying concentration of organisable labour, a safe base from which to extend, and a breeding centre for population which, being accessible, is capable of receiving assistance from us—is in any case a necessary preliminary to all measures of a large nature against the tsetse in the bush—that is to say, to *reclamation.* The production of it throughout the Territory will be gradual, and in certain parts it may prove to be impracticable, but appreciable success is already in places attending our initial propaganda

Concentration accomplished and the natives in our new culture steppes assisted to become the possessors of cattle (for these are necessary in order to "anchor" them), it will remain for them to protect themselves against encroachment of the bush and the fly and to expand their fly-free grazing *pari passu* with the increase in their cattle This, with tact and propaganda, will be done as we have already begun to do it in Shinyanga—through sheer clearing (as last year), for this appeals to the native, or better, through more discriminating measures which will be carried out by the people themselves under our guidance during a few days each year Here I would say that our victory in Shinyanga lay not in our large clearing of ground—many people have cleared ground (and then let it go back to bush and tsetse)—but in the successful teaching of a native population to tackle its own problems. Stiebel, McMahon, Scupham are my administrative collaborators to whom the credit for this is chiefly due.

Thereafter, as population increases (and we would help it to increase by means of propaganda in hygiene), the scheme is that we should so guide the directions of expanding settlement as to bring into being coalescence, and thereby complete our fly-proof barriers and break off our blocks—the latter corresponding, let us say, in width with so small a fly-belt as that of Zululand. These, being of more manageable dimensions than our entire belt, would next be attacked individually in order to obtain final security and room for the freest development

What methods are we to apply to the blocks? Lamborn's fine work in the breeding and release of parasites has been mentioned by Major Church This, in places, might prove a useful contributory measure Shircore, in an admirable little paper published in 1914, suggested, first, the concentration of attack on the dry-season centres of *G morsitans* (which would first, he suggested, have been isolated by clearing from the rest of the bush and finally be cut down themselves), and, secondly, for the further controlling of the movements of the fly (which can be done, he considers,

[1] I based this recommendation primarily on more than fifteen years of experiment and observation as to the results on woody vegetation of grass-fires lighted year after year in different months, but suggested that deferred fires would also have the other effects—on the pupæ and as to the driving of the fly on the wing into unburning thickets, which would themselves gradually be destroyed—which I shall describe below Shircore, in 1914, included grass-burning postponed to late July or August, for the clearing up and driving of any flies still scattered, amongst his measures of attack on the dry season centres of *G morsitans* Lloyd and Johnson have suggested that, long grass being inimical to breeding, the postponement of burning may be useful also for the prolongation of this unfavourable condition

My experiments in Shinyanga will be described in detail in the *Bulletin of Entomological Research*

even by narrow barriers), "the splitting up of fly-belts near villages and along main routes by forest destruction and burning" This, with the extension of agriculture, the clearing of villages and the attacking of the fly-centres, would ultimately, he thought, limit fly to areas which need not be entered by the natives I doubt whether, short of such concentration of population as would produce "culture steppe," these measures could maintain safe segregation in any considerable belt, but they are thoroughly sound in principle and probably roughly represent a part of the means by which the relatively small belts of South Africa were unintentionally cleared of fly by the early settlers Under such conditions I propose to use them freely

Jack has experimented on a large scale in the destruction of game—but while, here and there, the checking of particular movements, large or small, of game animals may, if it is also feasible, be very necessary, no one wishes to exterminate our wonderful African fauna, a heritage of the Empire, of posterity, and of the scientific world, if we can control the tsetse otherwise Our first results in Tanganyika lead to the very strong hope that we can, at least in the type of belt in which I have worked chiefly of late (Acacia-bush with *thickets* as the keynote to the fly's control, much like the fly-bush seen by me in Zululand), and suggest that we should wait a little longer before we commit ourselves finally anywhere to counsels of despair in the form of war against the game [3]

I have mentioned my own views already on the utilisation of man-power and the grass-fires and on discriminative clearing, and I think that the diversion of native energy and settlement—or European energy and cultivation where that is present—to the destruction and breaking up merely of the locally-important types of thickets, is likely to be a most valuable measure, because thickets are the chief breeding place of most species of tsetse and a refuge for all during fires I am employing this already in conjunction with late grass-burning

As regards the latter, I demonstrated last year (and, concerning certain points, many years previously) the correctness of the view stated in my Portuguese report, that postponed and organised grass-burning is capable, where the grass and the dry season are long enough, of destroying small woody growth and numbers of the smaller thickets, logs and (to judge from a comparative count obtained at Shinyanga) pupæ, and of driving the flies before the fire in great numbers into previously burned patches and such unburning thickets as are as yet uncleared. Our work suggested that in these places they can be exterminated (given the labour) by sheer catching on a great scale by hand and otherwise before they disperse There can be little doubt also that by means of October grass-burning Father Cirvegna, a missionary in the Iringa district, has cleared of fly (*G morsitans*), progressively but completely, an area a dozen miles in diameter in three burnings The measure is not applicable everywhere.

[3] I may here correct an error that has slipped into a quotation of Major Church's from a conversation with myself—undoubtedly through my not making myself clear It is by no means the whole of the Dar-es-Salaam district that is "gameless," and bush-pigs are present in any case The point is that bush-pigs, by any methods now known to us, are, I believe, inexterminable in certain tsetse-infected types of woodland that cover great areas of Africa, and that, from observations made, I consider that these animals can alone support populations of fly sufficient to preclude the keeping of cattle

An exceptional season appears to have been responsible for the disappearance of the fly in 1921 from some of the out-jutting portions of the Shinyanga belt Had there existed fly-proof barriers between these and the main belt, they would not have been re-stocked. It is thus, and for the accentuation of the effect of late grass-burning, once this is installed as an annual custom, that I suggest that we shall "harness the exceptional season" for the clearing of some of our blocks.

Finally, the verification by Harris of views held by him (for example as to the possibility of isolating tsetses in particular pieces of bush until, as I understand it, they starve) is likely, when it comes, to help greatly

I am experimenting also in Shinyanga as to consolidation of ground gained We are offering inducements to natives to settle where their activities will be of use, introducing a rule that villagers should keep down young shoots from cleared growth round their villages, experimenting in the encouragement of the keeping of goats for their browsing, trying to induce people in culture steppe to dig up stumps for firewood rather than make journeys to the bush for it, and experimenting in cheap methods of killing woody growth The encouragement given by our Department of Agriculture to the use of ploughs by the natives is helping me, for ploughing entails the removal of stumps, and we are diverting so far as possible large-scale cotton culture by means of ploughing to the actual ground I am clearing The replacement of great thicket-areas by high forest (in this form, an idea of Fiske's), the safeguarding of roads, the means of reducing the carrying of fly into contact with cattle by man, and the testing of three important questions in connexion with the game, including its possible utilisation as an ally in our fight with the tsetse, are amongst the further experiments which are already in progress or contemplated

In short, with the very hearty co-operation of the other Departments and of the District Administration, I have put into effect and, I think, begun to justify the view, that we can now best advance our knowledge of how to fight the tsetse by taking a definite large area or entire Territory and applying to it, without stint of necessary funds and labour, all ideas and knowledge that have been gained hitherto, and all further knowledge we yet shall gain, in a large-scale experiment in control by means (preferably) of reclamation officers working hand in hand with research officers The latter are still needed for expert "survey," for the many points which will come up for investigation as we go along, and because, for economical and effective work, our knowledge of our flies' habits and habitats must be absolute, and, should funds become available, they will be needed in some numbers, in order that, as they master thoroughly the details of the problem and the work in the field (which it would take new men, unattached, some years to do), many may pass on from the earlier centres to other parts of Africa and assist in making the campaign general. Especially is needed a large fund to meet the various expenses of a scheme which shall provide for this gradual development of large-scale experimentation in actual control under all African conditions; that is, at the stage we have now reached, the right method of research

The Phylogenetic Classification of Flowering Plants.

By John Parkin.

THE epithet, phylogenetic, in the above title might be considered superfluous, as all biologists are agreed that a taxonomic arrangement of any group of plants or animals should, so far as possible, follow evolutionary lines; after that, its convenience should be considered. Strange to say, up to the present, no arrangement of the Flowering Plants (Angiosperms), which has been generally adopted in text-books or used for floras, merits the term phylogenetic—hence the insertion of the word in the heading to this article.

Of the two chief classifications in use at the present time, that of Bentham & Hooker never outwardly professed to be a phylogenetic arrangement, while that of Engler, though apparently launched as such, has proved unworkable from the evolutionary point of view, and bears the impress of being artificial in its main contention, namely, the primitiveness of the apetalous unisexual flower of few parts Surely, then, the time is ripe—some would say long overdue—for the introduction of a new system embodying up-to-date views respecting the evolution and possible origin of the flower. A strong movement in this direction is being taken by Mr. J. Hutchinson of the Kew Herbarium, and a series of papers by him, entitled "Contributions towards a Phylogenetic Classification of Flowering Plants," are appearing in the *Kew Bulletin*.[1] It is the purpose of this article to invite the attention of botanists to these papers, and at the same time to review briefly the general position and trend of this department of botany.

Kew has never adopted Engler's system. It has hitherto remained faithful to that of Bentham & Hooker as expressed in their classical work the "Genera Plantarum" But at last it shows unmistakable signs of breaking away and of inaugurating a new arrangement on logical lines As it controls largely the systematic botany of the Empire, such a system is bound to make headway, so it is incumbent on those botanists who are interested and sympathetic to give it their attention and helpful criticism, in order that it may benefit thereby before it becomes too stereotyped. A new system cannot be fully worked out all at once. Hutchinson's method of publication by a series of preliminary papers gives ample opportunity for this kind of criticism, and we are sure that such comments will be much welcomed He has already enunciated his principles and dealt in detail with some of the important families[2] composing the Ranales upon which his system is based; and last year he published his proposed rearrangement of the orders (cohorts) and families constituting the Archichlamydeæ of Engler (the equivalent of the Polypetalæ and Apetalæ combined of older classifications) These papers are not only worthy of the attention of the taxonomist, but also of the general botanist They infuse new life into a department of botany which at times is apt to savour too much of the kind of material with which the systematist usually deals.

It is well to remember that, prior to the publication of "The Origin of Species," systematic botany was under the influence of the dogma of the constancy of species. Since systematists then adhered to the belief that the different forms of plants were special creations, the idea of primitiveness was not involved—it had no meaning. Consequently it was largely optional as to which group was given the initial place in a system. Two chief tendencies, however, are noticeable with respect to the Dicotyledons—one the placing of plants with incomplete flowers lacking petals (the Apetalæ) first, and the other, the putting of the Ranalean families (Ranunculaceæ, Magnoliaceæ, etc.) into this prominent position. One may be said to have culminated in the classification of Engler and the other in that of Bentham & Hooker. The former system in a measure owed its initiation to Brongniart, who in 1843 suggested that the apetalous division of Jussieu ought to be abandoned on the ground that these flowers are an imperfect state of polypetaly This was a remarkable step forward on the part of this French botanist, considering it was ventured at a time when the principle of evolution was not generally accepted The German school later, while putting into practice to some extent Brongniart's suggestion, *e g* in uniting the apetalous Chenopods with the petalous Caryophylls—the stock example—made no attempt to interpolate the whole of the apetalous families among the Polypetalæ, but instead diverged on novel lines by postulating, or at least inferring, the primitiveness of unisexual flowers of few parts, such as we find in the catkin-bearing trees and Casuarina

Bentham & Hooker made no attempt to apply Brongniart's principle They adopted the Candollean classification, modifying it in certain respects De Candolle was the first to commence a dicotyledonous sequence with the Ranalean families, and Bentham & Hooker followed suit. They both treat the apetalous families as a sort of miscellaneous appendage, after dealing with the whole of the Polypetalæ and Sympetalæ. It is interesting to note that no phylogenetic significance was attached to the position assigned to the Ranalean families.[3] Intuitively they appear to have alighted upon the primitive group.

Hutchinson's aim is to reconcile, as it were, the two opposing systems at present in use, on one hand, by taking the Ranalean families as his base and, on the other hand, by making full use of Brongniart's principle. He considers such a system, broadly speaking, phylogenetically sound, and with this the present writer is in agreement.

Among British systematists Engler's system has met with tardy acceptance. The conservatism of Kew has probably been the restraining influence—a conservatism which now appears justified. In universities, however, it has by now been generally adopted, apparently without criticism Doubtless Engler's great name, coupled with the publication in association with Prantl of that colossal, finely conceived and beautifully illustrated work "Die Naturlichen Pflanzenfamilien," which marks an epoch in botanical literature, prevailed upon botanists to accept the

[1] *Kew Bulletin*, pp 65 and 241, 1923, pp 49 and 114, 1924

[2] Ranunculaceæ, Winteraceæ (detached from the Magnoliaceæ) and Anonaceæ.

[3] See, in this connexion, a letter dated May 13, 1907, from Sir J D Hooker to Dr Newell Arber, reproduced in "Life and Letters of Sir J D Hooker" (Leonard Huxley, London, 1918, vol. ii, p. 22).

system. It appears to me to be a most difficult one upon which to frame a course of instruction in what is known, for want of a better term, as systematic botany. Perhaps, though accepted in the abstract, it is largely ignored in the class and lecture-room! But there is the self-taught botanist to consider, and he has only text-books on Englerian lines for his guidance.

Let us glance at the difficulties in the way of regarding Engler's system as even remotely phylogenetic It is based essentially on the character of the perianth: the mere fact of relying on one organ for his sequence arouses suspicion as to its naturalness. He commences with families possessing flowers without a perianth or with sepals only, passes to those with a petaloid perianth, and then to those with a definite calyx and corolla There is no evidence of the perianth arising in this *de novo* fashion, as outgrowths from the floral axis, as presumably is the supposition Besides this, we are committed to the difficulty of deriving the hermaphrodite from the unisexual flower. In both cases the evidence—and there is an abundance—points the other way, namely, that the absence of the perianth or of one set of sexual members is due to reduction. In regard to the catkin families (Amentiferæ) and the like, with naked or apetalous flowers, where obvious links with petalous hermaphrodite forms are not to the fore, surely it is simpler on circumstantial evidence to look upon these flowers as very reduced, than to view them as being primitive in character. Further, it is to be noticed that such flowers are grouped in dense and often complicated inflorescences—an arrangement which cannot be taken as primitive

A considerable controversy has centred around the supposed primitiveness of the Amentiferæ on other grounds than the character of the flower. This has arisen in part through Treub's classical researches on Casuarina published in 1891, and in part through the hope of deriving the Angiosperms from the Gnetales through this group. The Amentiferæ consequently received a considerable amount of attention, especially as regards the internal structure of the ovule. All attempts, however, to connect the catkin-trees with the Gnetales have proved abortive, or at any rate far from convincing Treub's discovery of the peculiar way (chalazogamy) in which the pollen-tube penetrates the ovule in Casuarina, though hailed at first as a primitive character of prime importance, can now only be regarded as secondary and of little or no phylogenetic significance. The Amentiferæ may possess some primitive features in the ovule and in the structure of the wood, but they do not appear to have a monopoly of these. In one point the Magnolian group surpasses them, for certain of its genera lack vessels in the wood, and so are gymnospermous in this respect. It would thus appear quite feasible to regard the Amentiferæ as having come as an early offshoot from Ranalean stock along reduction lines There is some evidence for their affinity with the Rosales generally, and with the witch-hazels (Hamamelidaceae) in particular. Hutchinson favours this view

In certain quarters in which the Amentiferous flower has been accepted as primitive, the Ranalean flower has also been admitted as a primitive type. The logical outcome of such an expression of opinion would surely be to infer a polyphyletic, or at least a diphyletic, origin for Angiosperms. But there are grave difficulties in such an inference. At the present time I venture to think that the vast majority of botanists regard the Angiosperms as monophyletic; that is to say, an interrelated assemblage of plants which have arisen from one source Apart from other considerations, one has only to dwell upon the unique type of embryo-sac and the same kind of stamen (microsporophyll) prevailing throughout the group to be convinced of this. Ruling out, then, the possibility of a mixed origin for Flowering Plants, the derivation of all forms of flowers from the Ranalean pattern,[4] especially as exhibited in Magnolia and its allies, would appear to be the only feasible one, thus affording a basis upon which to erect a phylogenetic, or at any rate a logical, system of classification.

The Monocotyledons have so far not been mentioned. Though various views have been held in the past regarding their relationship to the Dicotyledons, there is now a consensus of opinion that they have had a dicotyledonous origin. In other words, their ancestors possessed seedlings with two seed-leaves (cotyledons). How the monocotyledonous seedling with its single seed-leaf arose from the dicotyledonous one is still a matter of dispute. The Monocotyledons must perforce have branched off at a very early period, as the two groups are traceable back to rocks of about an equal antiquity.

It is then on morphological rather than geological evidence that the dicotyledonous derivation of the Monocotyledons is favoured. It is difficult to interpret otherwise their peculiarities, such as the single cotyledon, lack of cambium and style of leaf. Consequently, in a new system of classification which professes to be phylogenetic, they should follow, and not precede, as Engler has them, the Dicotyledons Hutchinson, I believe, intends to place them so. Two points now arise which affect their arrangement. Have they had a single or plural origin from the Dicotyledons? Though no precise answer can yet be given to this query, the present writer sees no cogent reason for regarding them as other than a natural self-contained group Then it may be asked from what dicotyledonous assemblage of plants can they be derived? The floral features in common between some of the water-lily family (Nymphæaceæ) and the Helobieæ (water-plantain, flowering-rush, etc) suggest something deeper than mere parallelism It may not therefore be unduly straining affinities to derive the Monocotyledons from the Ranalean plexus The Helobieæ can then be treated as the primitive group, at any rate so far as floral features are concerned. The question of the origin of the Monocotyledons is largely bound up with that of the habit of their immediate ancestors Henslow, years ago, suggested an aquatic origin, and though this was seriously challenged by the late Miss Ethel Sargant in favour of a geophilous origin, it cannot yet be dismissed. The truth may lie somewhere between Just as in the Dicotyledons, lines of both advancement and reduction with respect to the corolla (petals) can be traced. One of the former has ended in the Orchids, with their

[4] A hermaphrodite flower, in short, with its members indefinite in number, free from one another, borne spirally on a conical axis and arranged in a definite sequence on this axis, namely, proceeding from below upwards, first perianth members with no clear separation into sepals and petals, then stamens, and finally carpels

extreme specialisation for insect-pollination, and one of the latter in the Grasses, well adapted for pollination by the wind. Disregarding the teleology, we believe there is a substratum of truth in the following lines:

They tell us that the homely corn that grows,
From russet stem and leaf, our daily bread,
Was once a lily, which by various steps
Of menial work, became degraded thus,
It left its high-born sisters in their robes
Of gorgeous idleness to clothe itself
In this plain dress for common household use
Its bright-hued petals, nectar cup, and store
Of fragrance sweet, that insect lovers wooed,
It sacrificed; and only wandering winds,
That have no sense of beauty or delight,
Now woo its sober blooms with heedless sighs.
But for this noble humbling of itself
God has more highly honoured it, to be
The chief support of human beings, made
In His own image—rulers of the world

(To be continued)

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R.S.

10. HERMANN HELMHOLTZ (1821–1894), HEINRICH HERTZ (1858–1894), AND RONTGEN (1845–1923)

THE names of Helmholtz and Hertz remain connected together in my mind probably because, when I met them towards the end of their lives, the conversation with both mainly turned on the nature of cathode rays: Hertz adhered to the idea that they consisted of vibrations, while Helmholtz from the beginning stood up for the corpuscular theory, and was rather sore that the idea did not originate in his own laboratory During the few months I was working there, at the end of 1874, Goldstein was engaged in the important researches which the Royal Society has recognised by the award of the Hughes Medal His experiments, which showed that the rays emanating from a cathode were strongly repelled by an adjacent parallel electrode, were sufficient to convince Helmholtz that the rays consisted of a projection of negatively electrified matter, but Goldstein did not fall in with this view "Of course," said Helmholtz to me a few years later, "as soon as Stokes became acquainted with Crookes's experiment he guided him into the right path"

In his early years Helmholtz seems to have been very sensitive to criticism Roscoe used to relate how he found him once in great distress, complaining that his whole scientific career was endangered because some one had thrown doubt on one of his conclusions

The Physical Laboratory of Berlin in 1874 contained only three or four rooms, with about a dozen students engaged in researches on a number of subjects mostly suggested by Helmholtz In his daily rounds he used to discuss scientific problems freely with each in turn. He was as quick as Kelvin in being able to shift his mind quickly from one subject to another, but, in contrast with Kelvin, there was always a good deal of the *Grand Seigneur* in his attitude, and the title of *Excellency* bestowed upon him was borne with great dignity He relaxed to some extent in his annual visits to Pontresina, where I received much encouragement from him in my early attempt to form some consistent theory of the passage of electricity through gases

Her Excellency—his second wife, and a member of the South German aristocracy—was fond of society and gave weekly musical parties at their home in Berlin She was of a highly strung and nervous temperament. During one of their visits to England they were staying with Roscoe at Manchester, and one morning she came down to breakfast complaining that she had been very ill during the night She woke her husband, saying "Hermann, I am going to die." "That is easier said than done," replied Helmholtz, turning round to sleep again At one of his visits to Roscoe, he was accompanied by his daughter The conversation turned on the possibility of flying "It would be beautiful," said Miss Helmholtz, "one could escape so easily from one's chaperon, but then perhaps girls would be put into cages"

The intimate relations which Helmholtz maintained with Kelvin are referred to in the biography published by Konigsberger I may quote here the passage from a letter written by Helmholtz to his wife while on a visit to Lord Kelvin

"The former (James Thomson) has a good brain with clever ideas, but he will not listen to anything except about engineering and talks about it at all hours, day or night, so that no other subject of conversation has a chance in his presence It is amusing to watch each of the brothers (William and James) insisting on explaining something to one another, and neither of them listening to what the other says. But the engineer is more persevering, and generally gets his own way

"In the meantime I have seen a number of new and ingenious appliances of William Thomson's, and had two interesting days here in consequence But Thomson's thoughts follow each other so rapidly, that one can only obtain the necessary explanations about the working of his instruments, etc, by a series of questions to which it is difficult to get an answer How his students can understand him is beyond me, as they cannot permit themselves to make the efforts to keep him to the point, which I could venture upon All the same, a number of students were working in the laboratory and seemed to know what they were doing . Thomson's experiments did for my new hat He set a heavy metallic disc, balanced on a point, into rapid rotation, and in order to show me how the disc became immovable by the spin—he struck it with a hammer. The disc revolted against this treatment and flew off to one side, projecting the iron stand in the opposite direction. The stand split my hat and carried it away. The disc happily did no damage beyond breaking some glasses"

As is well known, the original suggestion that Hertz should undertake the experimental demonstration of the propagation of electrodynamic waves according to Maxwell's theory came from Helmholtz The research could be undertaken only by one who possessed exceptional abilities both on the theoretical and experimental

[1] Continued from p 306

side The merit of the execution belongs to Hertz alone. Towards the end of 1888, he communicated his first decisive success in obtaining waves of comparatively short length so that he could, by means of a parabolic mirror having an aperture of two metres, form a parallel beam and confirm previous results Helmholtz wrote in answer "I was much pleased with your latest feat It concerns things at the possibilities of which I have nibbled for years in the hope of finding a hole by which to enter I am therefore familiar with your line of thought, and its great importance is quite clear to me." In the same year Hertz had the choice of accepting a professorship at Berlin or Bonn, the vacancies occurring through the deaths of Clausius and Kirchhoff Hertz decided for Bonn, and Helmholtz, approving the choice, writes "Whoever is still able to carry out extensive scientific work is well advised to keep away from large towns" The great appreciation of Hertz's work by Helmholtz is shown by the unusual course he took in proposing the posthumous award of a certain prize to Hertz. He justified the proposal on the ground that it may "discharge a debt of the nation, inasmuch as Hertz during his lifetime had been much less honoured by his countrymen than by other nations"

In my own intercourse, I found Hertz to be a man of extreme modesty. During one of my visits to him, he received the news of some distinction the Academy of Sciences of Vienna had bestowed upon him He seemed worried by it "Too many honours," he said, "are as bad as too few They do not add to the pleasure and only create jealousies" With regard to the fundamental question of cathode rays, he attached great importance to an experiment he had made, which showed that they could pass through gold leaf, and looked upon this as telling in favour of waves, to which I could not agree.

I am told that in early youth Hertz gave expression to weird ideas with regard to possible happenings if some of the ordinary circumstances of life were changed.

It is sad to think that the illness which led to his death was probably aggravated, if not caused, by the unsanitary state of his laboratory, which, as I am told, had been built and used as a hospital for certain contagious diseases

The succession of experimental discoveries leading, through Hertz, to the important researches first of Lenard and then of Rontgen is well known I never spoke to Rontgen, and hearing of his presence in another hotel during one of my visits to Pontresina, I called on him He was not at home, but I saw his wife, who received me in a friendly manner The call was never returned, though amends for this want of courtesy were made a few months later. Returning to Manchester from a short Christmas holiday at the end of the same year, I called at the laboratory on my way home from the station On looking at the accumulated correspondence, I opened a flat envelope containing photographs which, without explanation, were unintelligible Among them was one showing the outlines of a hand, with its bones clearly marked inside I looked for a letter which might give the name of the sender and explain the photograph. There was none but inside an insignificant wrapper I found a thin pamphlet bearing the title "Über eine neue Art von Strahlen," by W C. Rontgen This was the first authentic news that reached England of the discovery of the so-called X-rays I sent a translation of the paper to Nature, where it appeared on January 23, 1896

Obituary.

Sir Edward Thorpe, C B, F.R S

Although Sir Edward Thorpe had been unwell for some considerable time, yet his well-known energy and virility were so remarkable that it came as a shock to his many friends to learn that he had passed away on Monday, February 23, at his beautiful Devonshire home by the sea, Whinfield, Salcombe. It was an ideal residence in his retirement, for he could there enjoy his favourite relaxation of yachting, and take any one of his three yachts out to sea for a sail just as readily as taking a walk, which the hilly roads and paths of South Devon had latterly rendered a matter of difficulty for him

Carrying my mind back to the year 1885, when I had already been two years as a Royal Exhibitioner at the Royal College of Science, South Kensington, I remember the gratification with which we students learnt that our retiring professor of chemistry, Sir Edward Frankland, was to be succeeded by Prof Thorpe, whose reputation at the Yorkshire College, Leeds, had gone before him I had previously studied under Sir Henry Roscoe at the Owens College, Manchester, where Dr Thorpe had held his first appointment as demonstrator on Sir Henry's staff, and this fact, together with a personal introduction to the new professor from the latter's father-in-law, Dr John Watts, proved a bond of attachment, which, after my third year as student, but working in the research laboratory, led to collaboration with Prof. Thorpe in several years of research on the oxides and other compounds of phosphorus, and to a demonstratorship and lectureship which lasted eight years, indeed, until Sir Edward, in 1894, left South Kensington to become Principal of the Government Laboratories

Sir Edward was born in the Harpurhey suburb of Manchester on December 8, 1845, his father, Mr. George Thorpe, having been a merchant of that city At the close of his student days at the Owens College he went to study under Bunsen at Heidelberg, carrying with him a letter of introduction from Prof. Roscoe, who had himself been a pupil of Bunsen Moreover, young Thorpe was entrusted with a present from Roscoe to Bunsen, namely, some well-formed crystals of potassium and sodium, which Roscoe had placed in separate bottles under rock-oil, as usual with the alkali metals In the throes of packing, the young student economised space by placing both metals in one of the two bottles, the crystals being sufficiently different to be distinguishable. After presenting his letter, he duly brought forth the bottle, removed its paper covering, and ceremoniously presented it to Bunsen as containing unique specimens of potassium and sodium crystals The great chemist looked hard at the bottle and then at his visitor, who then first realised that something was wrong. For, instead of metallic crystals beneath the rock-oil, there

was nothing but a shining liquid resembling mercury. He was beginning to fear that the great master would suspect a practical joke, of doubtful taste, when suddenly Bunsen's face lighted up with a great smile, and he told the would-be new disciple that his first research should be the investigation of this new liquid; he then welcomed him heartily to Heidelberg. The sequel revealed no joke, but the important new fact that sodium and potassium unite to form an alloy, which is liquid at the ordinary temperature, and closely resembles mercury in appearance

While at Heidelberg, Thorpe had Victor Meyer for both laboratory companion and lodgings partner, so that the well-known great friendship between them dates from that time. After taking his Ph.D. degree, Thorpe spent a short time in the laboratories of Bonn, after which he returned to Manchester and took up his duties as demonstrator under Roscoe.

In the year 1870 two important events occurred in Thorpe's career, namely, his first professorship in chemistry, at the Andersonian College, Glasgow, and his marriage to Caroline Emma, the daughter of Dr Watts, chairman of the Lancashire and Cheshire Institutes and of the Manchester School Board, and one of the ablest of the pioneers of higher education In 1874 came the call to the newly established Yorkshire College, Leeds, where he made the chemical department renowned for its efficiency and its output of original research. His painstaking and highly accurate determinations of the specific volumes of liquids of definitely related chemical composition, involving new and refined modes of determining their densities and thermal expansions, led to very important conclusions concerning chemical constitution, and he was elected a fellow of the Royal Society in 1876

On taking up his appointment to the chair of chemistry at South Kensington in 1885, Thorpe suggested to me a research on the oxides of phosphorus, especially with the view of identifying, or if necessary of discovering, the lower oxide, supposed to be P_2O_3 This oxide had really not hitherto been isolated, for the supposed descriptions of it turned out eventually to be quite absurdly erroneous. The professor's first instruction, however, was one which greatly impressed itself at the time, and one which might with great advantage be more generally followed in commencing a research it was to spend several days in studying and abstracting all the known literature on the subject, from both books and original memoirs

This research extended over six years, and resulted in the publication of four joint papers. The first paper, published in the Journal of the Chemical Society in 1886, concerned an altogether new oxide of phosphorus, the tetroxide P_2O_4, which we obtained in excellent crystals instead of the expected P_2O_3 for which we were searching The second paper was published in the same journal in 1890, and described the isolation and eventual successful determination of the constitution and properties of the so-called trioxide. It proved to be a white waxy solid, melting to a colourless liquid at summer temperature (22° C), and boiling, in an inert atmosphere, undecomposed at 173°, and affording a vapour density which indicated precisely the double formula P_4O_6 and not P_2O_3 The third paper, also in the same journal, was published in 1891, and described a number of interesting reactions and additive compounds of the new phosphorous oxide The fourth paper gave further details of one of these addition compounds, phosphorus sulphoxide, $P_4O_6S_4$, in preparing which on several occasions very lively and dangerous explosions occurred, one of which left the nearest of us on the floor. This fourth paper was contributed to the newly projected *Zeitschrift fur anorganische Chemie*, being the first paper in the first number published (February 27, 1892) of that journal

One of the most satisfactory things about the results of this research was the establishment of the fact, by the kind collaboration of the late Sir Lauder Brunton, that the oxide P_4O_6 was the cause of the necrosis of the jaw from which workers in match factories so frequently suffered The knowledge gained in the research was eventually the means of entirely avoiding the production of the oxide during the manufacture of matches, and consequently brought about the total disappearance of this terrible disease

During his tenure of the chair at South Kensington, Sir Edward Thorpe carried out the determinations of the atomic weights of gold and silicon, in collaboration with Dr A P Laurie and Mr. Young respectively, and also a prolonged research on viscosity with Mr. J W Rodger, which formed the subject of the Bakerian Lecture to the Royal Society in 1894. The wonderful delicacy and dexterity of manipulation manifested in these researches was even more fully exemplified in the research on the atomic weight of radium, which was carried out by Sir Edward at the Government Laboratory, and formed the subject of his second Bakerian Lecture in 1907 He also carried out at South Kensington researches on some volatile fluorine compounds in collaboration with Mr Rodger and with Mr. Walter Kirman

A further important research of a totally different kind was the magnetic survey of the British Isles, which Sir Edward commenced while at Leeds and continued when at South Kensington, in collaboration with Sir Arthur Rucker, who was similarly transferred from Leeds to South Kensington as professor of physics. The writer has some special knowledge of the immensity of this work, as he made the computations and maps for the first survey, that of Scotland Sir Edward Thorpe's yacht was of great assistance in this part of the work, especially as regards the stations on the west coast, and among the isles His love of the sea was also the cause of his taking part in four solar eclipse expeditions, those of 1870, 1878, 1886, and 1893 The first proved unduly exciting, for H M S *Psyche*, carrying the members of the expedition from Naples to Sicily, was totally wrecked

After sixteen years at the Government Laboratory, Sir Edward returned to South Kensington as professor of general chemistry at the Imperial College of Science and Technology He finally retired at the close of the War with the title of emeritus professor He had been knighted in 1909, after receiving the C B in 1900 He was the recipient of a Royal Medal from the Royal Society, of which he was foreign secretary from 1899 to 1903, and was the first Longstaff medallist of the Chemical Society, of which he was president (after being for a number of years treasurer) from 1899 to 1901 He received honorary degrees from several

universities at home and abroad, and was an honorary member of a great number of learned societies throughout the world. He was president of the Society of Chemical Industry in 1895, and in 1921 of the British Association at its meeting in Edinburgh This last occasion saw the beginning of his illness, for he was taken ill on arrival in Edinburgh, and was unable to deliver his presidential address on atomic structure, which was read for him by Sir Alfred Ewing

It is only possible in the space left at my disposal to mention briefly Sir Edward's brilliant lecturing and literary ability His early books, "Chemical Problems," "Inorganic Chemistry," "Quantitative Analysis," and "Qualitative Analysis," were used by thousands of students, while his great "Dictionary of Applied Chemistry," now appearing in a new edition, is a monumental work of the utmost importance to industrial chemistry His biographies of Dr. Priestley and Sir Humphry Davy, the "Essays in Historical Chemistry," and his "History of Chemistry," are most readable and entertaining, as well as of scientific value, giving the personal touch which is so charming to the wonderful events in the evolution of modern chemistry Finally, his "Yachtsman's Guide to Dutch Waterways" and "The Seine from Havre to Paris" are permanent records of a master yachtsman and valuable guides to later comers in the yachting world, whether their vessels be propelled by wind, steam, or petrol

Sir Edward Thorpe thus passes from our ken in his eightieth year, full of honours as of years, and with a published record of scientific work which it is given to few scientists to achieve He leaves no children, so that our sympathy will therefore go out in all the greater measure to his lifelong companion, Lady Thorpe, who has so devotedly watched over and cared for him, and made his home a paradise

A E H TUTTON

MISS L. S. GIBBS

MISS LILIAN SUZETTE GIBBS, the news of whose death at Santa Cruz, Teneriffe, on January 30, came as a shock to her botanical friends at home, had done good work both as an investigator in the laboratory and as an explorer in many parts of the world After a two years' course at the Swanley Horticultural College, she entered the Royal College of Science as a student in the Department of Botany under Prof. J B Farmer From that time onwards her life, which might have been one of leisure, was devoted to the pursuit of science She became a research student at the College, and the value of her work was attested by the award of the Huxley medal and the prize for research in natural science

Miss Gibbs became early interested in the floristic side of botany, and collected in the Alps of Switzerland and Austria. In 1905 she visited South Africa with the British Association and collected in Southern Rhodesia and at the Victoria Falls. But her great contribution to floristic botany was her work on the mountain flora of various parts of the world Between 1907 and 1915 she visited successively the mountains of Fiji, Mt. Kinabulu in British North Borneo, the Arfak Range in Dutch North-west New Guinea, the Bellenden-Ker Range in Queensland, and the mountain plateaux of Tasmania Each of these expeditions formed the subject of a memoir—published in the Journal of the Linnean Society, the *Journal of Botany*, or the *Journal of Ecology*—in which she described her observations on the plant-formations, discussed questions of distribution of plant-life, and gave a systematic account (with the assistance of experts in some of the groups) of the very considerable collections which she brought back A complete set of these collections is in the Department of Botany of the British Museum, where her floristic work was elaborated. She retained, however, her interest in structure and development, and her papers in the *Annals of Botany*, especially one on the development of the female strobilus in Podocarpus, based on her own collected material, are valuable contributions to this aspect of botany

Miss Gibbs was a woman of strong personality, and keenly interested in the question of equal rights for her sex She was one of the earliest women fellows of the Linnean Society and the Royal Microscopical Society, and was also a fellow of the Royal Geographical Society She had many friends, who deeply regret that her work is finished, and to whom her death comes with a sense of personal loss

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THE world of geography has sustained a serious loss by the death of Mr. John Bolton, which occurred after half an hour's illness on February 22 Mr. Bolton was in his eighty-third year, having been born in 1842 In 1857 he entered the service of Mr Edward Stanford, the grandfather of the present head of the firm of Edward Stanford, Limited, and although of recent years he had only acted in a consulting capacity, his connexion with the firm was continuous until his death Many leading cartographical works were produced under his direction, including the London Atlas series of maps, Stanford's 6-inch and 4-inch scale maps of London, and their series of library maps In 1884 Mr Bolton was appointed geographical expert to the Congo conference at Berlin, and in 1897 served on the Venezuela Boundary Arbitration, being loaned by the firm to the government for such service. He was a life member of the Royal Geographical Society, and attended regularly the meetings of the Geographical Section of the British Association, including the visit of the Association to South Africa in 1905 He was also a fellow of the Royal Colonial Institute In the course of his career Mr Bolton had been associated with many famous men, including General Gordon, H. M Stanley, Cecil Rhodes, Lord Kitchener, Capt. Scott, and Sir Ernest Shackleton. He possessed a personality that inspired confidence, and a geniality that endeared him to all with whom he came in contact.

WE regret to announce the following deaths:

Dr Adolph Kemna, corresponding member of the Zoological Society of London and formerly president of the Royal Zoological and Malacological Society of Belgium and of the Belgian Society for Geology, Palæontology and Hydrology.

Dr C Symes, president in 1897 and 1898 of the British Pharmaceutical Conference, on February 13, aged eighty-five

Dr A de Watteville, for many years editor of *Brain* and distinguished for his work on the nervous system, on February 24, aged seventy-eight

Current Topics and Events.

Two subjects of philosophical and physical investigation have excited deep interest during recent years, the theory of relativity and the theory of quanta These were discussed by Dr J H Jeans in his Kelvin Lecture on "Electric Forces and Quanta," delivered on February 5 at the Institution of Electrical Engineers, and published as a special supplement to this week's issue of NATURE The first part of the lecture deals with electric forces in the light of the theory of relativity, and it is claimed that, as all the phenomena go on as though there were no ether, the conception of an ether is superfluous If an ether does exist, it must probably be thought of as a four-dimensional structure and must be largely subjective The generalised geometry of Einstein and Weyl can predict and explain all the systems of forces of the universe, both gravitational and electrodynamical But geometry does not explain the atomicity of electric charges or the essential difference between positive and negative electricity Again, quantum theory indicates the existence of discontinuities in Nature of a kind not contemplated in the older mechanics No one is better qualified to deal with the implications of this theory than Dr Jeans, whose report on radiation and the quantum theory published by the Physical Society of London has long been a mine of information for those interested in the subject Some of the ideas adumbrated in the final chapter of that report have now been developed further It may well be that the atomicity of the quantum theory is only another aspect of the atomicity of electric charges The quantum theory represents, perhaps, a quality of the four-dimensional continuum, which is somehow analogous to the scaliness of a crocodile skin This is equivalent to the suggestion that the "calamoids" or four-dimensional tubes of force of Prof Whittaker should be regarded as quanta Our conception of the action of an electric field on an electron seems to require revision in the light of a recent hypothesis due to Einstein The electric forces in Maxwell's equations serve in some way to measure the *probabilities* of jumps in the velocity and perhaps also in the position of an electron in an atom

THE numerous statements that have been made recently by politicians and others about the great economies that could be effected by erecting very large electric generating stations are sometimes very misleading to the public. It is pointed out that, by the use of these super power stations, the cost of the coal used per unit of power generated would be halved It is generally concluded, therefore, that the cost of power to the consumer would be reduced by a half When we remember, however, that only from 20 to 25 per cent of the total cost of generating a unit is due to the coal used, it will be seen that the reduction of price to the ultimate consumer would only be about 12 per cent, and not the 50 per cent which the public have been led to expect. Similar conclusions apply to water power. We have received from the Smithsonian Institution of Washington an excellent report, by S S Wyer, on the power possibilities and preservation of Niagara Falls It is pointed out that the erection of the requisite hydro-electric plant is less than half that of the total scheme Few realise that about 80 per cent of the cost of delivering the energy to the resident consumer is incurred after the power has left the generating station The money used for carrying out an enterprise, whether state-owned or not, must ultimately come from individual owners, and they have an obvious right to receive a hire or rental for it An interesting comparison is made between the systems adopted on the Canadian and on the American side of the Falls In Canada the Government owns about 79 per cent of the hydro-electric system The service in Ontario is not taxed, so that the lowering of the cost to the consumer is done at the expense of the tax-payers of the districts in which the property is located On the American side, about 10 per cent of the price of the service has to be paid for taxes The rate of recession of the crestline of the Canadian Falls, which carry 94 per cent of the water, is about 5 feet per annum On the American side it is only about 2 inches per annum Methods of preserving the scenic beauty of the Canadian Falls and preventing them from "gradually committing suicide" are discussed

A STEP, which may eventually be one of far-reaching importance, has recently been taken by the authorities of the London School of Hygiene and Tropical Medicine They have appointed a Rhodesian Research Fellow in the person of Dr G R Ross, at present lecturer in the University of Leeds and a former graduate of the University of St Andrews This development is the direct outcome of the co-operation which existed between the Government of Southern Rhodesia and the old London School of Tropical Medicine whereby, on two occasions, Dr J G Thomson, Director of Protozoology at the School, visited Southern Rhodesia and carried out research work in connexion with blackwater fever The results of Dr Thomson's useful inquiries have appeared in the form of a well-illustrated monograph, a pioneer publication Dr Andrew Fleming, the Medical Director, Southern Rhodesia, felt, however, that this was merely a beginning and that the question of blackwater fever, and indeed of other tropical maladies, was so important from the point of view of the white settlers and of the general development, not only of Southern Rhodesia but also of the whole chain of Central African tablelands, that measures should be taken to ensure a continuance of such research work He found his Government in a sympathetic mood and, together with Sir Francis Newton, the High Commissioner of Southern Rhodesia, he approached the Board of Management of the London School of Hygiene and Tropical Medicine after some preliminary discussions with the Director of the School Eventually it was arranged that, for a period of three years, the Southern Rhodesian Government, in addition to making an annual grant

towards the expenses of the Field Station, would undertake to provide laboratory accommodation and equipment together with travelling expenses in Rhodesia for one or more research workers to be appointed and sent out by the London School In accordance with this arrangement, Dr Ross, accompanied by a trained laboratory assistant, will leave England in March

SIR OLIVER LODGE's fifth broadcast talk from the London Broadcasting Station 2 LO on "Ether and Reality" was delivered on Tuesday, March 3 His subject was "Electromagnetism How Radiation is Generated" An electron at rest has nothing magnetic about it, but the path of a moving electron is surrounded by magnetic lines of force, as an umbrella might be surrounded by indiarubber rings When the electron is suddenly stopped, these rings are "shocked" off, spreading out as a pulse or shell of radiation with the speed of light, carrying away the energy and momentum A moving electron has additional mass when stopped, this mass disappears as a quantum of radiation, the size of the quantum depending on the previous speed There are strange unexplained facts looming ahead of us Sometimes, Sir Oliver said, we feel as if radiation were a half-way stage between ether and matter Matter is discontinuous Is light discontinuous? Is light a kind of matter which is bound to travel at a fixed speed, unless perchance it be modified into an electron? The difficulty and the interest of the problems before us are only equalled by the ingenuity with which they are being attacked The eternity of the cosmos seemed at one time in doubt by reason of the dissipation of energy now there is some glimpse of a way out Matter tends to fall together gravitationally, but radiation tends to spread to the confines of the universe, and however diluted it retains its vigour What becomes of the quanta? Why is no speed greater than that of light possible? Some revelation is dawning upon us, and confronted with a majestic vision of reality, we—like those other explorers on their first view of the Pacific Ocean—have

"Look'd at each other with a wild surmise—
Silent, upon a peak in Darien"

SIR JAMES C IRVINE in his discourse on Friday evening, February 27, at the Royal Institution, dealt with sugars from the point of view of the organic chemist Within the last fifty years many new sugars have been isolated from natural sources, others, unknown in Nature, have been prepared synthetically, formulæ have been ascribed to them, and in many cases the structure has been determined In order to make further progress, a new phase must be entered upon when only such reactions of the sugars will be studied as proceed under conditions approaching closely to those which obtain in the living tissues, conditions which will not admit of the use of solvents or reagents inimical to life, and in which the optical, electrical and thermal factors will be rigidly controlled Above all, new types of synthesis are required, and only when the chemist resolves to regard it as a crime to conduct a sugar-reaction at the boiling point is there any real hope for sugar chemistry Eighty years ago Faraday was investigating the electrical properties of cane-sugar, and the recollection inspires the hope that the research now associated with the Royal Institution may again be applied to the whole series of carbohydrates What a prospect is opened up when a well-founded conception of constitutions based on both physical and chemical evidence shall have been acquired

AT the forty-seventh annual general meeting of the Institute of Chemistry held on March 2, the president, Prof G G Henderson, after referring to the loss sustained by British chemistry by the death of Sir George Beilby, one of the past presidents, announced that the Council had invited the co-operation of the Society of Chemical Industry and the Institute of Metals, of which Sir George had also been president, in establishing some fitting memorial in his honour The Institute was frequently invited to appoint delegates to participate in public inquiries Such invitations were welcomed, but the Council had felt obliged to give expression to a mild protest that provision could not be made to lighten the sacrifice of time and expense which the duties of such representatives entail The Council was diffident about asking fellows who were resident in the country to attend Government committees at their own cost and without emolument The attitude of authorities towards scientific men had been reflected in the speeches of Ministers of the late Government, who apparently regarded the professional scientific man in the civil service as a very useful person in an ancillary or subordinate position, but it should be insisted upon that scientific departments should be controlled by competent scientific men Chemists who were also capable men of affairs were available, many such held high positions in industry, and they were coming more and more into positions of control It was the business of the Institute to ensure the supply of such chemists for the benefit of the country The following officers for the year ending March 1926 were elected *President*, Prof G G Henderson, *Vice-Presidents*, Prof E C C Baly, Mr E R. Bolton, Mr A Chaston Chapman, Dr T Slater Price, Prof A Smithells, Mr E W Voelcker, *Hon Treasurer*, Mr P H Kirkaldy At the conclusion of the formal business, the president, supported by Prof Thomson, made a presentation, on behalf of the fellows and associates, to Mr Richard B Pilcher on completing thirty years as secretary and twenty-five years as registrar and secretary of the Institute In the evening the Council entertained Mr and Mrs Pilcher and their family to dinner at the Hotel Russell, followed by a reception.

ON February 28, at 9 23 P M, a strong earthquake was felt in the eastern United States and Canada. The first accounts do not suggest a shock of unusual or destructive intensity, but it is possible that its importance was not fully realised at the time the messages were sent Two facts in the brief reports seem to indicate the severity of the earthquake. One is its great duration, even supposing that the estimate

of four minutes at New York was much exaggerated The other is the magnitude of the disturbed area An earthquake that was noticeably felt in New York, Richmond (Virginia), Louisville (Kentucky), Chicago, and Montreal must have disturbed a district at least 750 miles in diameter and containing not less than 450,000 square miles, that is to say, an area greater than that affected by the San Francisco earthquake of 1906 At New York the movement was strong enough to break the writing pointer of the seismograph at Fordham University. It was recorded at West Bromwich and, no doubt, at many other places in Europe

AN important conference upon applied microscopy is to be held in Sheffield on April 20 next and following days under the auspices of the Royal Microscopical Society at the invitation of the University of Sheffield, the civic authorities, the Master Cutler, and the loca technical colleges and research associations A local committee has been appointed representative of the academic and industrial research interests, and the programme includes a large number of communications and discussions dealing with technical problems connected with iron and steel, wood, coal, paper, textiles, industrial diseases, and microscopical optics Visits to works and laboratories are being arranged, and an imposing exhibition of instruments and apparatus will be open throughout the meeting It is also hoped to arrange with the railway companies to grant cheap travelling facilities to those attending the conference The conference is open to all interested in technical microscopy, and full particulars can be obtained from the Secretary, Royal Microscopical Society, 20 Hanover Square, London, W.1, or from the Local Secretary, Mr. E J Thackeray, Dept of Applied Science, University of Sheffield

THE fifth International Congress of the History of Medicine will be held at Geneva on July 20-25, with Dr. Charles Greene Cumston as president and Sir D'Arcy Power as president of honour The following papers among others will be read medical operations in the stone age, by M Eugène Pittard of the University of Geneva, Albert von Haller and the "Disputationes chirurgicae selectae," by Sir D'Arcy Power, Robert Whytt, an eighteenth-century neurologist, by Dr John D Comrie, the history of typhoid fever in the child, by Prof P Gautier, a letter of Tronchin and the Suttonian method of inoculation, by Dr J G de Lint, Voltaire and medicine, by Dr J D Rolleston, goitre at Geneva in the Middle Ages, by Dr E Wickersheimer, Lavater and his successors, by M Fosseyeux, a note on the history of diagnosis in medicine, by Dr F G Crookshank, a letter of Girolamo Fracastoro on poetry, by Dr J W. S Johnsson of Copenhagen, historical researches on the history of anatomy in the Ateneo Romano, by Dr P Capparoni, medical literature of the seventeenth century as exemplified in the Elzevir Press, by Dr. E B Krumbhaar, hygiene and public health in the early civilisations, by Mr C J S Thompson, the origin of veterinary art, by Sir Frederick Smith, the history of magic in the cure of disease, by Prof. Jeanselme, Martin Luther and his noises in the ear, by Prof G Bilancioni, a medical congress at Rome in 1681–82, by Dr C. G Cumston, and Benjamin Waterhouse, an American pioneer, by Dr J W Courtney Further information can be obtained from the general secretary of the Congress, Dr A de Peyer, 20 Rue Général Dufour, Geneva

THE new journal entitled *The Industrial Chemist and Chemical Manufacturer* constitutes a somewhat novel departure in the sphere of chemical journalism, because it will be the only monthly publication of its kind in Great Britain, and because it is very attractively got up The general style resembles that of some American journals which contain articles profusely illustrated and advertisements very effectively displayed It is interesting to note that in the new publication the advertisements of many old-established firms that have, apparently, never been radically changed within living memory, appear in an entirely new dress—the designs and the letterpress being entirely novel In the journal proper the main feature is the large number of articles, many of which are written by well-known authorities. Among the subjects treated are vanadium, saccharin, power alcohol, petroleum refining, glass, disintegrating mills, lime, vegetable adhesives, disinfectants, and adhesives The manner of treatment may be described as not severely technical, the object being to attract and interest not only the chemist, but also those employed in or associated with chemical undertakings, including the works' manager and the directorate, who may have no expert knowledge of chemistry This is a field which has hitherto been neglected or inadequately cultivated, and in extending a welcome to the new publication we express the hope that it will be particularly successful in fulfilling this part of its programme

ON Tuesday, March 10, at a quarter past five, Prof E N da C. Andrade will begin a course of two lectures at the Royal Institution on the evolution of the scientific instrument, and on Thursday, March 12, Dr Leonard Hill will deliver the first of two lectures on the biological action of light The Friday evening discourse on March 13 will be delivered by Prof Gilbert Murray, on the beginnings of the science of language, and on March 20 by Prof J. W. McBain, on soaps and the theory of colloids

APPLICATIONS are invited by the Board of Management of the Christie Hospital, Manchester, for the post of cancer research worker, whose duties will be to carry out research work on the blood in cancer Candidates should have a medical qualification and experience in clinical, pathological, and biochemical methods The latest date for the receipt of applications, which should be sent to Dr C Powell White, Christie Hospital, Manchester, is March 13.

AT the annual general meeting of the Physical Society held on February 13, the following officers were elected *President*, Mr. F. E Smith, *Vice-Presidents (who have filled the office of President)*, Sir Oliver J Lodge, Sir Richard Glazebrook, Dr C

Chree, Prof H L Callendar, Sir Arthur Schuster, Sir J J Thomson, Prof C Vernon Boys, Prof C H Lees, Sir W H Bragg, Dr Alexander Russell, *Vice-Presidents*, Dr E H Rayner, Dr J H Vincent, Dr D Owen, Mr C R Darling, *Secretaries*, Prof A O Rankine, Imperial College of Science and Technology, Mr J Guild, National Physical Laboratory, Teddington, Middlesex, *Foreign Secretary*, Sir Arthur Schuster, *Treasurer*, Mr R S Whipple, *Librarian*, Mr J H Brinkworth.

THE series of Early Chellean hand-axes found during 1924 by Mr Reid Moir upon the foreshore, and in a deposit representing the base of the Cromer Forest Bed, at East Runton and elsewhere on the Norfolk coast, is now being exhibited in the Museum at Ipswich, and the specimens can be examined by any one desirous of doing so The early flint implements of East Anglia are now arranged in the following sequence, which illustrates the succession of human cultures in Late Pliocene and Early Pleistocene times, namely, (*a*) specimens of Harrisonian eolithic type, (*b*) pre-Chellean forms from beneath the Red Crag, (*c*) Early Chellean hand-axes from the base of the Cromer Forest Bed, and (*d*) Chellean, Acheulean, and Mousterian implements from various deposits in Suffolk and Norfolk

THE Soviet Government of Russia has taken steps to protect the *zubr* or European bison, and incidentally other rare forms of life, in the Western Caucasus, by declaring an area of about 250,000 dessiatins, or approximately 625,000 acres, a reserved area under the control of a special official with the title of *zubrovni zapoviednik* Within this area " all activities damaging the natural relief of the surface, such as the felling of timber, pasturing of cattle, opening of quarries, etc ," are forbidden.

THE Cambridge Instrument Co, Ltd, have issued a new list, No 194B, dealing with thermoelectric pyrometers The catalogue deals in succession with general principles, indicators, recorders, thermocouples, cold junction control, and pyrometer tester. The latter is a compact form of potentiometer suitable for checking the accuracy of any type of thermoelectric potentiometer An interesting item is the new thread recorder, which is enclosed within a robust moisture and fume-proof metal case instead of the customary teak cabinet Recorders of this type are supplied making up to six records on one chart These may include records of temperature, carbon dioxide percentage, and carbon monoxide percentage It might be remarked that the carbon monoxide indicating apparatus is a development of the carbon dioxide type The amount of carbon monoxide is obtained by a differential measurement of the carbon dioxide present before and after the flue gases are passed through a small electric furnace containing copper oxide which converts any carbon monoxide present into carbon dioxide

ERRATUM —The words " on the Use of Preservatives and Colouring Matters in Food " appearing on p 222, col 2, of the issue of February 14, in the concluding sentence of the review entitled " The Chemistry of Flour Milling," were inserted in error after the author had passed his proof The Report of the Departmental Committee already published makes no reference to the bleaching and improving of flour, but a further report will appear in due course

Our Astronomical Column.

THE DISTANCE OF THE ANDROMEDA NEBULA — There have been several very discordant estimates of the distance of this object A new one has now been made by Prof Hubble, and is briefly described in *Popular Astronomy* for February He has found several Cepheid variables in the nebula, determined their periods, and deduced their absolute magnitudes in accordance with Prof Shapley's formula The resulting distance of the nebula is 950,000 light years, a distance which would make it of the same general order of size as our galaxy

This is probably a more trustworthy estimate than those previously made, a possible correction might arise from absorption of some of the stars' light in traversing the nebulous matter

A note in *Popular Astronomy* points out that the 7th magnitude Nova that appeared in the nebula in 1885 would at this distance have been 140 million times as bright as the sun

ANNUAIRE DU BUREAU DES LONGITUDES, 1925 — This little handbook is now very well known, and contains as usual, a large amount of useful information —astronomical, meteorological, physical, geographical, political, etc

The special essays this year are by M E Fichot on the effect of the earth's rotation on the tides, and by M G Ferrié on the use of lamp valves in wireless telegraphy and telephony, with applications to astronomy A little more care would seem to be called for in editing the astronomical tables p 289 gives the revolution of Mercury 2 days too great, a very serious mistake, p 302 in giving the elements of Neptune's satellite omits to notice the very interesting variation in its orbit plane

The information about the comets of 1923 is not up-to-date, much better elements of comet 1923 *a* were available months ago The object described here as comet 1923 *b* was found to be a minor planet more than a year ago there are, moreover, three misprints of proper names in the account of it, " Harward," " Seegrave," " Crowford ", p 310 gives the erroneous period 12 1 years (more than a year too short) to Tuttle's comet This mistake has been repeated for several years and has misled many people This period was deduced from a short arc, and was not intended to be taken as accurate

UNION OBSERVATORY, CIRCULAR 62 —This circular, dated last June, contains a number of important observations, which include the transit of Mercury (third contact 24 seconds before Nautical Almanac, fourth contact 35 seconds before), also long series of observations of Reid's Comet 1924*a* and Eros, which were too far south for European observers, also 114 occultations of stars by the moon, observed in 1923, which are fully discussed There are reproductions of the spectra of Nova Aquilæ on 21 days, June 11–August 10, 1918, which are conveniently arranged for studying changes The identity of the Nova with a 10th magnitude star in the Algiers astrographic catalogue was independently detected by the blink microscope at Johannesburg.

Research Items.

PREHISTORIC POTTERY IN PERU —Messrs A L Kroeber and D D Strong, in a study of the pottery from Ica collected by Dr Max Uhle for the University of California some years ago, pay a well-deserved tribute to the valuable but too little recognised work of this archæologist in South American, and especially Peruvian, archæology In the case of the pottery from Ica now described in University of California Publications in American Archæology and Ethnology, vol 21, No 3, and in the case of the pottery from Chincha, of which an account by the same authors appeared in a previous issue, they find that their independent study completely corroborates Dr Uhle's suggested classification and sequence in all important respects The pottery from graves in the Ica Valley, which lies on the coast of southern Peru, is classified into seven periods, as against the three at Chincha, representing more or less successive culture phases—Inca, late Ica II and I (corresponding closely with the three phases at Chincha), Middle Ica II and I, Early Ica or Epigonal, and Nazca or Proto Nazca The last named is unique and distinctive in colour, design, and shape The stylistic development from Middle Ica I to Inca is so continuous that when once Inca is accepted as latest, any other sequence is impossible The Ica Epigonal and Middle Ica are undoubtedly related to Tiahuanaco style, but it is difficult to see that Epigonal represents a decadence of Tiahuanaco styles as Uhle supposes

THE THEORY OF SENSE DATA —In a lecture published in the Journal of the Royal Astronomical Society of Canada, Dr H H Plaskett expounds what he calls the descriptive view of science This is the view that the objective content of science consists exclusively of the data of sense, that these sense data are not subjective aspects of reality but the actual non-mental content of the scientific object itself which is a construct of them, that the metaphysical concepts of substance and cause have no place in science, which can quite well dispense with them, that the atoms and molecules of physics and chemistry are not real existents but concepts Dr Plaskett seems to have taken this view from the chapter on sense data in Hobson's Gifford Lectures and to find support for it in Pearson's " Grammar of Science " The first of these does not profess to be original, but gives an excellent account of the recent controversy aroused in philosophical circles by the new realism of Mr Bertrand Russell and Dr Broad If Dr Plaskett had gone directly to the origin of this theory in modern times, Mach's " Theory of Sensations," he would probably have been aware of some difficulties of his descriptive view of science which are unnoticed in his lecture Mach found, in fact, that, try as he would, he could not get scientific objects out of sense data, they are not implicit in them, and yet only as sense data do scientific objects exist for us at all Mach spurned metaphysics, and he put forward as the only alternative to a scepticism like Hume's a theory of psycho-physical parallelism This for him was the only possible way of objectifying scientific knowledge The ideal of a science of pure description, renouncing all explanation, is no new thing It goes back at least to Bacon, but it has never proved satisfying to the restless spirit of scientific inquiry Since Berkeley, the problem of perception has made it still more disconcerting It is well, however, that we should be continually reminded of the initial difficulties, even the paradoxes, which surround the problem of the true method of scientific procedure

CUTTING SEED POTATOES —Potato growers frequently hesitate to cut their seed potatoes on account of the uncertainty as to the yield per plant and to the growth and healthy development of the cut sets This second point has been investigated by J H Priestley and G C. Johnson (Journ Min Agric 31, No 11), who indicate the precautions needed to eliminate this uncertainty The healing of the cut surface of a tuber is brought about by the deposition of a suberin deposit, which forms a barrier to the entry of moulds and bacteria capable of attacking and rotting the tuber If the potato is cut in moist air this suberin layer is continuous over the whole surface, but if the air be dry the suberin is patchy and organisms are able to penetrate through the cracks between the patches, thus damaging the tuber Field trials have proved the importance of this fact Similar tubers of Great Scott were cut and exposed to sun and air for 24 to 48 hours, or kept in a damp, warm place for the same time Much heavier crops were obtained with the latter treatment, 15½ tons against 6½ tons, 23½ tons against 14½ tons, etc, similar results being obtained with other varieties in other districts Apart from the question of yield, it appears that the certainty of growth from cut sets is much greater if precautions are taken to protect the sets from sun and wind after cutting before they are planted

OBSERVATIONS ON HOOKWORM LARVÆ —Dr L Fabian Hirst describes (*Ceylon Journ Sci*, Section D, Medical Science, vol 1 pp 1-26, 1924) investigations on the epidemiology of hookworm disease in Colombo His attention was directed to the problem in consequence of a severe outbreak of hookworm dermatitis and disease amongst coolies handling soil from certain trenches in a field used for the disposal of septic tank sludge The larvæ of Ancylostoma, Necator, and Strongyloides exhibit aerotropism, *i e* they attach themselves by one end to some fragment of fibre or similar substance on the surface of the soil and extend the rest of their bodies into the air, constantly moving as if in search of some additional support The movement of Strongyloides larvæ is more jerky and gyratory, the hookworm larvæ exhibit a slow undulating motion The author figures an apparatus in which buckskin leather is employed as a means of bringing about a separation between penetrative larvæ (which pass through the buckskin into a warm solution on the other side) and others present in the soil The species of the penetrative larvæ (Ancylostoma and Necator) can be definitely determined only after development to the sexually mature form in the intestine of a suitable host In laboratory experiments the author found that larvæ of *Necator americanus* could be recovered from the surface of infected soil for at least 108 and up to 124 days Larvæ lived about three months in water and fluid extracts of trench soil, they died much more rapidly in soils and fluids kept at blood heat than in the same media at room temperature

GROWTH IN INDIAN MOLLUSCS —In an account (Records, Indian Mus, vol xxvi pp 529-548, Nov. 1924) of his observations on growth in Indian molluscs, Major R B Seymour Sewell deals with five freshwater species and four marine brackish-water species —all gastropods except one (*Mytilus variabilis*) He examined 212 examples of *Pyrazus palustris*, which occurs in abundance in Nankauri Harbour, Nicobar Islands, in a swamp which is submerged at high water, and found that correlated with the gradual increase

in size is a remarkable change in the character of the radula So marked is the difference between the radulæ of the smallest and the largest specimens that one might reasonably doubt whether they belong to the same species In the smallest individuals, having a height of about 12 mm , the radula consists of rows of teeth—seven in a row (dental formula 2 1 1 1 2), each tooth possessing several cusps As growth proceeds the cusps on the teeth become gradually reduced in number until finally the central tooth presents only a single median cusp, the lateral tooth has a single cusp and a trace of a second one, and the two marginal teeth have a single cusp with traces of one or two small ones The reduction seems to be brought about by a process of fusion rather than by suppression, and, so far as can be ascertained, is not correlated with any change in the habits of the mollusc No corresponding change occurs in the other gastropods examined

BLACK SHEEP —Wensleydale sheep have white wool, but the skin of the face and ears is deep blue, and this colour may extend to other parts of the skin Breeders select for a maximum amount of pigment The breed produces about 15 per cent of black lambs, together with a number which are " pale blue " and very occasionally one which is pure white Mr F W Dry, from breeding experiments (*Journ Genet*, vol 14, No 2), concludes that the black is a simple recessive, since blacks bred together give only black offspring The same is true of blacks in certain other breeds of sheep The blue-faced sheep are found to be heterozygotes analogous to the Blue Andalusian fowl, in other words, a black sheep with a (dominant) white coat On the other hand, the Karakul sheep is a dominant black When crossed with white breeds, the lambs are pure black Such F_1 hybrids are now widely bred and their fleeces used as fur, but in the adult the colour becomes grey or dirty white In black Welsh mountain sheep the colour of the coat and horns is also apparently dominant in crosses Mr J A Fraser Roberts (*Journ Genet*, vol 14, No 3) describes experiments with this breed A pattern known as " badger-face " also occurs, which is white with black markings on the face, belly, and legs This appears to be recessive to both black and white In crosses between black and badger-face a white lamb has been known to appear Such cases of " reversed dominance " have been recorded in other breeds Their further investigation is a matter of much genetical interest The badger-face marking has also been studied by Wriedt in a Norwegian breed of sheep Individuals with reversed badger-face markings, *i e* black where white should appear and vice versa, are also known to occur

NEW PLANT ILLUSTRATIONS —Two numbers of *Curtis's Botanical Magazine* have recently appeared under the energetic editorship of Dr Stapf, being parts i and ii of vol 150, each containing plates of eleven plants, and each including one rhododendron and one primula, *R bracteatum* and *P Bulleyana*, in part i, *R glischrum* and *P melanops* in part ii Other interesting plants in part i include *Stellera Chamæjasme*, an example of a small genus of Thymelaceæ that has not previously figured in the *Botanical Magazine*, *Lindmania penduliflora*, a Peruvian example of this genus of Bromeliaceæ which may be in Nature an epiphyte like so many of the family, although the immediate allies of this plant grow on the ground on the edge of the forest, and a species of the cactus-like genus of the Senecioneæ, *Kleinia stapeliiformis* Part ii includes some very striking plants, notably an epiphytic member of the Vacciniaceæ *Agapetes speciosa*, with brilliant scarlet flowers, a species of an Orobanchaceous genus, *Æginetia indica*, successfully raised at Kew as a parasite upon the roots of the sugar cane, which will apparently only grow upon the roots of monocotyledons, and a shrub from Natal, *Ochna serrulata*, with yellow flowers and very striking fruits, in which the blue-black drupelets stand out against a vivid background of vermilion-coloured, enlarged sepals

FOSSIL CRANE FLIES FROM SOUTH AMERICA.—Two species of crane flies have been discovered by G R. Wieland (*Amer Journ Sci*, 9, Jan 1925, p 21) in the Rhætic beds of Minas de Petroleo, south-west of Mendoza, Argentina The larger (*Tipuloidea rhætica*) had a wing spread of 2 6 inches, so that it rivalled in size the Australian " robber fly " The smaller form (*Tipulidites affinis*) had a wing spread of half an inch. This discovery emphasises the great antiquity of the Diptera

UINTACRINUS IN THE CHALK OF WESTERN AUSTRALIA —Remains of the free-swimming crinoid, Uintacrinus, have been found in the chalk of Gingin, Western Australia (T H Withers, Journ Roy Soc. W Australia, 11, 1924, p 15) This discovery gives important evidence of the age of the Gingin Chalk, since Uintacrinus is characteristic of the lower part of the Marsupites zone of the Upper Chalk, it also shows that this crinoid, hitherto known from Utah, Kansas, England, and Westphalia, had a very wide geographical distribution

THE DOLDRUMS OF THE NORTH ATLANTIC —The *Marine Observer* for February contains an article on " The Doldrums of the North Atlantic " by Mr C S Durst The author gives credit to Maury and Toynbee for their full discussion of this interesting region Toynbee's discussion was carried out with the perfection of minuteness, comprised by elaborate charts and voluminous letterpress It has the advantage of being based chiefly on the results from sailing ships, the observations being gathered by the Meteorological Office An attempt has been made at a further discussion which may be of scientific value, but with the present-day steam vessels the region for the sailor has lost much of its " torment " Fig 3 (p 21), to which the author attaches considerable importance, is at least for the first ten days open to considerable doubt so far as the northern and southern boundaries of doldrum in March 1923 are concerned, and the resulting width of doldrum certainly is not 600 miles as given in the text

ICE IN THE BALTIC SEA —Among a number of interesting publications on various aspects of Baltic meteorology and oceanography published by the Havsforsknings Institutet of Helsingfors a particularly detailed paper deals with the occurrence and distribution of sea-ice during the winter of 1920–21 (No 22, Isarna Vintern, 1920–21) The observations, which were gathered at coast stations and Finnish lightships, are given in full and entered on a series of coloured maps for the Gulf of Bothnia, the Gulf of Finland, and the Finnish water of Lake Ladoga. These charts show the beginning of the ice in the north of the Gulf of Bothnia in early December and its gradual extension southward In the year under review the waters of the Aland Archipelago were not blocked until late January, but soon after that date fast ice extended across to the Abo Archipelago and the coast of Finland and remained until early March. The period of greatest extension of ice in the Gulf of Finland was the middle to the end of February, when, as usual, the Gulf was more or less entirely blocked In early April the southern coasts of Finland were clear, while the western coasts cleared between the beginning of April and the middle of May These dates appear to have been earlier than usual This

and other publications of the Institute are in Swedish, with very brief German summaries

SPARK IGNITION —A knowledge of the conditions under which an electric spark in an explosive mixture of gases will initiate an explosion is of great importance in the mining, motor, and other industries, but the results of experiments made hitherto have been inconclusive. In a communication to the *Philosophical Magazine*, which appears in the February issue, Mr J D Morgan gives an account of his experiments on the igniting powers of inductance sparks in direct and alternating current circuits, and comes to the conclusion that the thermal theory of ignition is sufficient to cover all the known facts According to this theory, it is necessary to raise a sufficient volume of the gas in the immediate neighbourhood of the spark to a sufficiently high temperature before ignition results, and if both conditions are not satisfied the flame produced in the gas immediately in contact with the spark will not spread To satisfy them a certain minimum energy must be imparted to the gas in a fixed short time, and this is in general more easily done by a capacitance than by an inductance spark, but there is no difference between the effects of the latter when in direct or in alternating circuits The cooling effect of the electrodes is very marked and must be taken into account

TESTING PHOTOGRAPHIC PLATES —The February number of the Journal of the Royal Photographic Society is devoted to the first session of the Conference on the Standardisation of Plate-testing Methods which was held at the Society's house on December 9 The papers read and the discussions on them are given in full The subjects treated of at this meeting were (1) the light source, primary and secondary, (2) the exposure mechanism, (3) the development The first paper is from the National Physical Laboratory and deals with standards of light Of the standards at present available for sensitometry either the crater of the carbon arc or a gas-filled tungsten lamp, operating at a colour temperature of 2950° absolute, is recommended, but in either case definite specifications of details would have to be prepared Dr Helmuth Naumann gives a formula for a colour filter in gelatine which contains six different dyes, and changes the light from a vacuum tungsten filament lamp into "daylight" from about 3000 Å U to about 7000 Å U with sufficient accuracy for most photographic purposes It seems generally acknowledged that the intermittency error caused by rapidly revolving sector wheels placed in the path of the light should be eliminated With regard to development, it is argued on one hand that this should be uniform, and, on the other hand, that uniformity would not be fair, because different plates need different treatments to get the best results of which they are capable In all, ten papers were read and discussed

THE γ-RAY SPECTRA BY THE CRYSTAL METHOD — M J Thibaud has recently described experiments, in which the frequencies of monochromatic γ-rays are arrived at by converting the radiations into β-spectra, by means of the photoelectric effect on different elements, and measuring the energies of the electronic streams emitted In the *Comptes rendus, Acad Sci Paris*, of January 12, he describes how, using de Broglie's method, with a rotating crystal of rocksalt and photographic registration, he has been able to make measurements with angles α of reflection scarcely more than a fraction of a degree The velocity of rotation was less than 1° in twenty-four hours Glass tubes containing 40 mgm of radium bromide in equilibrium with its products were employed, and also a preparation of mesothorium The spectra consist of clear sharp lines, with no continuous bands, and the following values have been found for radiothorium or mesothorium

No	Int	λ in Å	Energy in volts	Origin
1	strong	0 168	73,500	—
2	,,	0 145	85,000	Rd Th
3	weak	0·062	198,000	,,
4	medium	0 052	236,000	Th B

The indirect method gives 233,000 for the energy in volts of a γ-ray from thorium-B, which agrees with No 4 above within the limits of probable error, this line has been found by Meitner and by Ellis Fräulein Meitner assumes a γ-ray 0 146 Å to explain the β-radiation of radiothorium, which agrees with No 2 The origin of No 1 is not explained Rays with energies of 273 and 298 kilovolts found by the indirect method, but weaker than the 233 kilovolt ray, have not as yet been observed directly The spectrum obtained with radium confirms the two lines found by Rutherford with α about 1° 30′

TYPOGRAPHIC INKS —The technology of printing inks is described by Dr N F Budgen in the *Chemical Trade Journal* for January 23 Typographic inks (used for book-printing, labels, etc) are softer and thinner than lithographic inks, which must be unaffected by water The essential constituents of printing inks, apart from the pigment, are the oil (usually linseed, though soya-bean, perilla, and other oils are often used), and the varnish (largely made from rosin oil) Cheap inks contain varnish made from mineral oils The pigments used for obtaining different coloured inks and the incorporation of the ingredients are described in detail Cheap black inks contain carbon black More expensive inks use a black made from rosin oil

SUGAR INDUSTRY IN GREAT BRITAIN —The English beet-sugar industry is described in an article in the *Chemical Trade Journal* for January 23 The first factory to be erected in England was put up near Maldon (Essex) about 1832 It did not continue long, and the next factory, erected at Mount Mellick, Queen's County, Ireland, in 1851, also closed down at an early date A works put up at Lavenham, Suffolk, in 1868, closed down ten years later, it was recommenced in 1885, but only worked for a few weeks. The primary cause of these initial failures seems to have been lack of beet, which the farmers would not produce in sufficient quantities The more recent schemes are mentioned The Cantley factory (near Norwich) was opened in 1912, it was closed during the years 1914–1920, but since the latter date it has operated each season The old and modern methods of refining beet-sugar are described, the modern bone charcoal filtration method does not appear to be used in England. Some possible developments in the sugar industry are described in *Chemistry and Industry* for January 23 The article is mainly concerned with the use of vegetable charcoal for refining purposes, it is more economical than bone charcoal One such charcoal is "suchar", whereas a factory turning out 200 tons of raw sugar daily requires about 600 tons of bone black for refining purposes, the same factory would require only about 30 tons of "suchar" It is claimed that this reduces the cost of refining by one half The "suchar," after it has been used twice, is washed and revivified by passing an electric current through it This burns off the impurities without impairing the activity of the carbon itself Glucose can now be obtained in a colourless crystalline form on a large scale, it is marketed as "ceralose" Crystalline fructose has also been obtained on a laboratory scale under conditions which make the transference of the method to the manufacturing scale almost certain of success

Physiological Standardisation.

THE use of substances in the treatment of disease has, probably in a majority of cases, been empirical for some time after their discovery and adoption, in fact, in spite of recent advances in chemistry, through which the actual structure of many drugs has been elucidated, pharmacology is in many instances only able to describe the actions of drugs on living tissues without at present finding it possible to give the actual reasons for these actions The problem is part of the wider one of the relation between chemical structure and physiological action In those cases where the chemical structure is known, it is easy to investigate the action of known quantities of the drug upon a number of organisms of the same or different species and thus arrive at the minimum dose which is effective, and at the maximum dose which is safe, for no drug is absolutely harmless when the dose has exceeded a certain specific limit But when a substance cannot be isolated in a pure state and its chemical structure is unknown, as is the case for example with the active principles obtained by extracting certain glandular organs, the sole indication of their presence being the effects they produce upon living tissues, it is essential, to get comparable results with different samples and to protect the patient against a possible overdose, to have an approximate idea of the strength of the sample in terms of its physiological action It is a common experience to find that extracts prepared in the same manner and containing a known amount by weight of the original organ, may yet differ enormously in physiological activity This variability is due to variations in the condition of the gland before extraction and to varying loss of the active principle during this process

To illustrate the methods used in physiological standardisation, those employed in assaying the active principle or hormone of the posterior lobe of the pituitary gland, commonly known as pituitrin, and that obtained from the pancreas, called insulin, may be described briefly, with special reference to recent work on the subject

Pituitrin acts as a stimulant to smooth muscle, affecting the muscle fibres directly, its main effect on intravenous injection is to raise the blood-pressure, but after administration per os, or intramuscularly, its absorption is too slow to produce this effect, and yet it will cause contraction of the uterus, an organ the contractile power of which is due to the smooth muscle in its wall. In clinical medicine it is used chiefly for the latter purpose in the later stages of labour Methods of assay have been based on its effects on the blood-pressure and on the uterus Dale and Burn (Medical Research Council Report, No 69) have given a detailed account of the latter the uterus of the virgin guinea-pig is used as the test object, and an extract of the posterior lobe of the pituitary, prepared in a certain manner, as the standard It would be convenient to use as standard a substance of known composition which could be obtained in a pure condition, having the same stimulant action on smooth muscle as pituitrin Unfortunately, tests with histamine and potassium chloride showed that uteri varied in sensitivity to these substances and to pituitrin independently

Hogben, Schlapp, and Macdonald (*Quart J Exp Physiol*, 1924, vol 14, p 301) have recently described a method of assay based on the rise of blood-pressure produced by intravenous injection It is not yet certain that the principles producing rise of blood-pressure and uterine contraction are the same, but a trustworthy method of assay of the former should be useful Hitherto, the difficulty has been that successive doses of pituitrin produce a diminishing rise, or even a fall, of blood-pressure, and therefore samples cannot be compared with certainty In part this is due to the presence in the extract of a substance causing a fall of pressure, this can be removed by alcoholic extraction of the gland extract, or its formation prevented by placing the gland in cold acetone, as soon as it is removed from the body Apart from this, however, frequent injections of a depressor-free extract produce diminishing effects until a complete immunity is obtained This can be obviated by spacing the injections at wider intervals The test object recommended is the spinal cat, and the extract must be depressor-free, since it is possible that the substance which causes a fall of pressure in the anæsthetised animal causes a small rise in the spinal preparation If a dose which is about half the maximum, and produces a rise of pressure of 55 mm Hg, is injected every hour, a 10 per cent discrimination between two samples is perfectly possible, since the effect of the previous injection has worn off in this time The chief objection to the method appears to be in the time taken, since injections are only possible every hour, the guinea-pig's uterus, on the other hand, can receive five or six separate doses in this time A further difficulty is that the preparation may vary slightly in sensitiveness during the course of an experiment, but this may be overcome by comparing the unknown only against adjacent injections of the standard

The standardisation of insulin is an even more complicated problem Its effect is to enable the tissues to utilise more carbohydrate both in health and in diabetes, when the pancreas is diseased, the simplest observation to make which shows this increased utilisation is an examination of the sugar of the blood, which falls after a dose of insulin But if it falls too much, unpleasant symptoms, including convulsions, are produced

Macleod and Orr (*J Lab Clin Med*, 1924, vol 9, p 591) have described in detail a method for assaying insulin based on the fall in blood sugar in rabbits Owing to the variability in the response of different animals, a number must be used in any single test, the conditions must also be standardised so far as possible since the level of the blood sugar is influenced by many factors, thus the animals must be starved for the preceding 24 hours, must not have a blood sugar much above 0 1 per cent, and must not be used for more than two or three months, when they become refractory and put on weight At least four estimations of the blood sugar are necessary in each animal, and the time occupied is considerable, hence a simpler method, if as accurate, would be preferable, and Margaret Cheadle (*Austral J Exp Biol and Med. Sci*, 1924, vol 1, p 121) has utilised the incidence of convulsions as a method of assay. In this case mice are used as test animals, and minute doses of insulin injected, and the incidence of convulsions in each group injected with the same dose noted After injection the animals must be kept at body temperature, otherwise they do not regularly develop convulsions If a mouse unit of insulin be defined as the amount necessary to give convulsions in 60 per cent of animals after subcutaneous injection, it must be correlated with the present standard, which is based on the fall of blood sugar in a rabbit, one unit being defined as the amount necessary to lower the blood sugar of a 2-kilo rabbit to 0·045 per cent in 5 hours. The unit used clinically is $\frac{1}{3}$ of the rabbit unit The author finds 167 mouse units equivalent to 1 rabbit unit

This somewhat cumbrous method of expressing the strength of insulin is necessary if comparable results are to be obtained in different tests with animals of varying weight A further complication has been found, in that some samples of insulin seem to contain a substance which may be described as an anti-insulin de Jongh (*Biochem Jour*, 1924, vol 18, p 833) gives an account of its properties its presence is only revealed when small doses of insulin are injected, as in rabbits, but in man its influence appears to be small It is apparently of a protein nature, and as the purification of insulin in the process of manufacture has been made more complete, the samples on the market at present appear to be free from it In any case it is an illustration of the difficulties encountered by those who have to measure the strength of substances of unknown composition and isolated only in an impure condition

Heterogeneous Equilibria

THREE papers by Mr. J. A V Butler, in the Transactions of the Faraday Society, February 1924, and two in the *Phil Mag*, October and November, deal with problems of equilibrium at the boundaries between solids and liquids, and between two solids The methods of statistical mechanics are applied in each case, and the first paper, "Conditions at the Boundary Surface of Crystalline Solids and Liquids," well illustrates the way in which other problems are dealt with

A diagram shows how the attractions of the solid and of the liquid on a molecule of the solute and their resultant are assumed to vary with distance from the surface, with a balance point at which the two opposing forces are equal A molecule from the surface will escape if, owing to thermal agitation, it has sufficient kinetic energy to carry it past the balance point Molecules which reach the balance point from the interior of the liquid are attracted to the surface An equation is deduced, similar to that of Langmuir, for the number of molecules reaching the boundary surface of a gas with kinetic energy greater than a certain quantity λ This equation, which contains the mean collision frequency, applies to the molecules moving in the liquid towards the surface, but not directly to the molecules in the surface, the only motion of which is a vibration about an equilibrium position The mean collision frequency is replaced in the equation for these molecules by a vibration frequency ν

An expression for the solubility is thus obtained which leads to the le Chatelier-van 't Hoff equation for change of solubility with temperature, one of the terms of which is the heat of saturated solution Assuming that ν is the characteristic vibration frequency of the solid, as determined by *rest strahlen*, and that the work done by the molecules from the surface layer, per gram molecule, in reaching the balance point is equal to the total heat absorbed in solution, unless this is less than the latent heat of fusion, when the latter is used, the author applies his equation to the alkaline chlorides. In this way he obtains results which are of the right order of magnitude

Similar methods are employed in a discussion of the E M F produced when a metal is dipped into a solution containing its ions The process is regarded as essentially a solubility phenomenon In the solution of a salt crystal, made up of positive and negative ions, both kinds are dissolved, but it is assumed that in the case of a metal, only the positive ions pass into solution, while the electrons which go to build up the crystal lattice are left behind Equilibrium is attained when equal numbers of positive ions are dissolved from and deposited at the surface in unit time. The negative charge due to the free electrons left on the metal retards the solution and assists the deposition, and to this extent the phenomena of salt solution are modified This is taken into account in the mathematical treatment of this case, with the result that a formula is obtained for the potential which, in form, resembles that of Nernst Instead of being based on osmotic pressure, however, it depends on the heat absorbed in the passage of the metal ions into solution, and on quantities defining the statistical conditions The values calculated from the formula are again of the right order of magnitude

In a third paper Mr Butler proposes a kinetic theory of reversible oxidation potentials at inert electrodes dipped into a solution containing two substances related by a simple oxidation reduction process An expression is obtained for the numbers of each of the two ions, M′ and M″, contained in the solution adsorbed by each square centimetre of the electrode, using a mathematical method similar to that applied above The reaction between each of these ions and the electrode is considered, one of them tending to gain an electron and the other to lose one, and an expression for the oxidation potential is obtained This is determined by the ionisation potential corresponding to the loss of an electron by the reduced molecule, the difference in the energies of hydration of the two substances, the thermionic work function of the metal and two statistical constants

Mr Butler deals with metal contact potentials in a paper in the *Philosophical Magazine* for October He obtains an expression for the potential difference at the surface of a single metal in a closed space containing an electron atmosphere, the loss of electrons from the surface of the metal being balanced by the gain of electrons from the atmosphere He then considers the case of two metals in the electron atmosphere, but not in contact, and finds that though the surface P D of each metal depends on the electron atmosphere *concentration*, the difference for any two metals is characteristic of them If the metals are brought into contact, the conditions at the surfaces not in contact are unaltered, and if there is to be no continuous flow across the junction, there must be a P D at the junction equal to the intrinsic P D of the metals The Peltier heat effect at the junction is explained, and the various equations of the thermionic effect are co-ordinated On certain assumptions they lead to the conclusion that the Thomson P D is the same for the same difference of temperature in all conductors

Finally, in a paper on the seat of the electromotive force of the galvanic cell (*Phil Mag*, Nov) Mr Butler co-ordinates the results of his previous papers, and derives a statistical theory of the galvanic cell The existence of large metal contact P D 's is not inconsistent with the correspondence between the E M F of the cell and the energy of the chemical reaction The metal contact P.D theory, the chemical theory, the Nernst theory of metal electrode potential differences and the relation between E M F and total energy change expressed by the Gibbs-Helmholtz equation are included in the new theory as different aspects of the whole truth

University and Educational Intelligence.

BIRMINGHAM.—The annual meeting of the Court of Governors was held on February 26. The report of the Principal (Mr. C. Grant Robertson), which was presented to the meeting, shows that during the last session the number of students diminished slightly as compared with the number for the preceding session. The total, however, is still 50 per cent. higher than in the year before the War. An encouraging fact is the increase in the proportion both of full-time degree students and of post-graduate students.

New buildings are to be erected at Edgbaston for the Petroleum Mining Department, and it is hoped that they will be ready for occupation by October next. The transfer of this department will give room for the expansion of the Department of Coal Mining. An effort is being made to provide further buildings, which are urgently needed, for an extension of the Department of Chemistry and for the removal of the Biological Departments to Edgbaston; but the great increase in the cost of building is a very serious obstacle to be overcome.

Two important events of the year have been the creation of a chair of law (of which Mr. C. E. Smalley-Baker is the first occupant) and the establishment of a readership in geography.

CAMBRIDGE.—Dr. J. H. Jeans has been appointed Rouse Ball lecturer in mathematics for the present academic year.

LONDON.—Mr. J. H. Dible has been appointed to the University chair of pathology tenable at the London School of Medicine for Women. Prof. Dible studied at the University of Glasgow. In 1919 he was appointed lecturer in pathology in the University of Manchester and assistant pathologist to the Manchester Royal Infirmary, and in 1921 lecturer in bacteriology and senior assistant in the Department, carrying out work both for the Ministry of Health and for public bodies and hospitals in Manchester and adjacent towns.

The title of reader in economics in the University has been conferred on Dr. Hugh Dalton, in respect of the part-time appointment which he will hold at the London School of Economics from August 1, on his resignation of the Sir Ernest Cassel readership in commerce. The title of emeritus professor of hygiene in the University has been conferred on Prof. H. R. Kenwood, who held the Chadwick chair of hygiene at University College from 1904 to 1924, and the title of emeritus professor of medicine at University College on Sir John Rose Bradford, who occupied at that College the chair of materia medica, pharmacology, and therapeutics from 1895 to 1903, and the chair of medicine and clinical medicine from 1899 to 1907.

The School of Pharmacy of the Pharmaceutical Society of Great Britain has been admitted as a School of the University in the Faculty of Medicine (in pharmacy only) for a period of five years as from January 1 last.

The following Doctorates have been awarded:— *D.Sc.* (*Biochemistry*): Mr. Robert Robison (Lister Institute of Preventive Medicine), for a thesis entitled "Hexosephosphoric Esters and their Physiological Functions"; *D.Sc.* (*Chemistry*): Mr. G. R. Clemo, for a thesis entitled "Strychnine and Brucine," and other papers; *D.Sc.* (*Physics*): Mr. Frederick Simeon, for a thesis entitled "1. The Carbon Arc Spectrum in the Extreme Ultra-Violet; 2. Note on the Striking Potential necessary to produce a Persistent Arc in Vacuum," and other papers; *Ph.D.* (*Science*)—Mr. L. Horton (Imperial College—Royal College of Science) for a thesis entitled "The Effect of the Alteration of the Carbon Tetrahedral Angle upon the Ease of Formation of Heterocyclic Rings"; Mr. A. B. Manning (Imperial College—Royal College of Science) for a thesis entitled "Researches on Gelatin"; Mr. E. G. Richardson (East London College) for a thesis entitled "Aeolian Tones, Vibrations excited by Fluid Motion"; Mr. J. W. Baker (Imperial College—Royal College of Science) for a thesis entitled "The Formation and Stability of Compounds containing Associated Alicyclic Rings (highly strained Rings)"; Mr. I. Cohen (Middlesex Hospital) for a thesis entitled "Observations on Variations in Blood and Urinary Diastase, with special reference to Meals and Starvation"; Mr. E. C. Dodds (Middlesex Hospital) for a thesis entitled "Observations on the Body Diastase," and other papers; Mr. W. Russ (University College) for a thesis entitled "1. The Phosphate Deposits of Abeokuta Province. 2. The Riebeckite Rocks of Northern Nigeria"; Mr. E. R. Trotman (University College, Nottingham) for a thesis entitled "The Preparation of Quaternary Hydrocarbons."

Prof. E. Barclay-Smith, professor of anatomy since 1915, and Prof. O. W. Richardson, appointed Wheatstone professor of physics in 1913 and relinquishing that appointment in 1924 on appointment as one of the Yarrow research professors of the Royal Society, have been appointed fellows of King's College.

A CONVERSAZIONE will be held at the Chelsea Polytechnic, Manresa Road, London, S.W.3, on March 13. The laboratories and workshops will be open for inspection, 6.30-10.30 P.M.

APPLICATIONS are invited for a research studentship in tropical medicine in connexion with the government of the Federated Malay States. The annual value of the studentship is 700*l*. Particulars of the post, and forms of application, are obtainable from the Private Secretary (Appointments), Colonial Office, Downing Street, S.W.1.

APPLICATIONS are invited by the Glamorgan Agricultural Committee for the position of instructor in dairy and poultry husbandry. Special knowledge of poultry keeping on the farm, and dairy farming (including clean milk production), and good technical qualifications are expected from candidates. Application forms (returnable by March 16 at latest) can be obtained from the Director of Agriculture, 5 Pembroke Terrace, Cardiff.

THE work of research has received a noteworthy and welcome stimulus at Armstrong College, Newcastle-on-Tyne. An anonymous gift of 12,000*l*. enabled the Council to establish a Research Endowment Fund in 1923, and the Committee which was appointed to administer the fund has published its first annual report. The Committee records its intention to utilise the proceeds to help members of the College and others with their researches by providing temporary or partial relief from teaching or by arranging for assistance, and by defraying the cost of books, apparatus, travelling and other expenses: thus to supplement the resources already in operation and not to supersede the provision available for the training of post-graduates. These considerations have guided the Committee in allocating grants during the first year. The Committee has also been able to arrange for a grant being given by the Newcastle and Gateshead Water Co. for a special research, and intimates a desire to advise or to co-operate with industrial firms and corporations desiring investigations in any particular direction. The opportunity has been taken to give a list of papers which have been published by members of the College staff during the year, and from this, although it is not exhaustive,

it is evident that all departments are actively engaged in research

LORD EMMOTT presided at an important meeting held in the Regent Street Polytechnic, London, on Friday, February 27, when the question of an inquiry into the relationship of technical education to other forms of education and to industry and commerce was discussed The case for the inquiry was presented by Lord Emmott and Mr J Wickham Murray (Joint Committee of the Three Technical and Art Associations) Their speeches indicated that, although technical education forms the contact-point between education and industry, its place in the national system of education is undefined Since, in any area, the technical institute draws its pupils from all other types of school, it is essential—if waste and overlapping are to be prevented—that its relationship to those other schools should be clearly understood Further, since technical education (including applied art) is the contact-point with industry, it is very necessary that more definite relationships be established if education is successfully to be linked to the world's work Educationists and industrialists seem more than ever to be sharply critical of each other's aims and methods, but no comprehensive attempt has been made towards sane and tolerant discussion of mutual problems It is now proposed to bring together not only primary, secondary, technical, and university teachers, but also employers, representative industrial and commercial bodies, and learned institutions Among the bodies represented at the meeting were the British Association, the Federation of British Industries, professional engineering bodies, teachers' associations, Institutes of Chemistry and Physics, and the British Science Guild The meeting finally resolved that the inquiry was desirable, and that the bodies represented be asked to appoint representatives to a committee whose work will be the preparation of the ground which the inquiry will cover

THE Parliamentary Grant (ordinary) for universities and university colleges in the British Isles, which was increased in 1921 from 1,000,000*l* to 1,500,000*l* (including 110,000*l* for Irish universities), did not escape the attention of the Geddes Economy Committee For each of the two succeeding years it was (for Great Britain only) 1,169,000*l*, and for 1924–25 it is 1,122,570*l*, excluding the new grants (amounting now to 120,000*l*) for Oxford and Cambridge Last November a deputation from all the universities of Great Britain, except Oxford and Cambridge, headed by Sir Donald MacAlister, waited upon the Chancellor of the Exchequer to urge the raising of the grant to 1,500,000*l* A letter on this subject from Mr Churchill to Lord Balfour, who introduced the deputation, was published in the *Times* of March 2 After reciting the salient points of the case presented by the deputation, which was very sympathetically received, the letter announces the stabilisation of the grant for five years at 1,380,000*l* (excluding provision for Oxford and Cambridge) For this relief the universities will, undoubtedly, echo the expression of thanks conveyed in Lord Balfour's reply, and if their gratification is tempered by regret that Mr Churchill has so firmly required them to forgo the expectation of any further increase for at least five years, they cannot fail to recognise that even this condition carries with it compensations, among which may be reckoned the greater precision and therefore effectiveness with which they will be able to define their needs when appealing for aid to local authorities, to alumni, and to the public The amount at which the grant has now been fixed (1,380,000*l*) is approximately 39 per cent of the aggregate annual expenditure of the universities concerned in 1922–23.

Early Science at Oxford.

March 7, 1683/4 —After ye reading of ye Minutes, Dr Plot was pleasd to acquaint ye Society that he had lately calcined clay-ochre, and stone-ochre (both which were yellow, from Shotover) about thirty-six hours, but neither of them applyed to ye Magnet, which gave ye Doctor grounds to question, whether yellow ochres will be affected by ye Magnet after any calcination, how long soever Tobacco-pipe clay, Marl, Bole armeniac and Terra Lemnia were calcined ye same space of time, but none of them applyed to ye Magnet

Then Dr Pit was pleased to inform ye Society that Oyl Olive is uncapable of any ebullition after it has spent its aqueous parts, which rise in bubbles, for, being pressed with a stronger fire, than what made water boyl over a large vessell, it could not be sensibly raised, although ye heat of ye oyl was so intense, that, being removed from ye fire, it broke out into a flame, and continued to do so after six or seven suffocations of ye flame Butter boyls over till its serous parts are evaporated, but afterwards, though pressed with a very great heat, is no more capable of ebullition, than so much melted lead

A Report of ye consultation, held for ye drawing up Articles, for ye better Regulation of ye Society, was offered, but ye examination of it was deferred, till ye next meeting which was ordered to be on ye Tuesday following, at 2 after dinner

March 8, 1686/7 —Dr Plot reported on the prices of commodities in the time of King John, which he had extracted from a Dugdale manuscript in the Ashmolean Library —Mr President wrote to Mr. Halley several arguments against Mr Hooke's late hypothesis of the change of the surface of ye Earth

March 9, 1685/6 —Dr Lister of London communicated a paper of Georgics concerning ye improvement of Sandy land by ye *Vicia multiflora nemorensis perennis sive Dumetorum* I B which is practised both in Yorkshire and Staffordshire

March 10, 1684/5.—Mr Maunders speaking of ye dismall weather on ye 23rd of December last, says, that above eighty Persons were found killed by it, in Wiltshire and Dorsetshire Some died suddenly, others by degrees some, that escaped, were so tormented in their hands, and face (parts exposed to ye cold) that, as they recovered, and ye swellings abated, the skin peeled off, and they were some days without ye use of their limbes, and sometimes of their senses —Part of Mr King's ingenious discourse of Bogs was read, and also Mr Aston's letter relating that ye Savages of Canada get from Maple juice a sugar as sweet as that of ye Canes.

March 11, 1683/4 —Salamander's wool was observed, by Mr Ballard, to be separated from ye earthy parts, to which it is joynd, by heating the Amianthus and bruising it into peices It was ordered, that some attempts should be made, towards ye working this wool into a thread, that so we may [if it be possible] either trace out ye methods of ye Antients, or equall their inventions with new ones in this kind, for ye effecting of which, Dr Beeston was pleased to take on him, ye trouble of employing some curious hand, suitable to so ingenious a design

March 13, 1687/8 —Mr Cole of Bristoll discoursed concerning the Descent of Spiders with their webs, taken in the County of Wilts in September and October 1686, with an occasionall discourse about Spontaneous Generation wherein is given allso an account of people that have been witnesses of the raining of frogs and crabs.

Societies and Academies.

LONDON

Royal Society, February 26.—E. H. **Starling** and E. B. **Verney**: The secretion of urine, as studied on the isolated kidney. The mechanism of urinary secretion in mammals has been studied by perfusing the dog's kidney with the heart-lung preparation. The glomeruli filter from the blood plasma its non-protein constituents. Hydrocyanic acid suspends tubular activity, while the action of hydrocyanic acid is reversible. Urea, sulphate, and, when present in the serum, phenosulphonephthalein, are secreted by the tubule cells into the glomerular filtrate. Water, chloride, bicarbonate, and glucose are re-absorbed by the tubule cells from the glomerular filtrate. Water appears to be re-absorbed lower down the tubule than chloride. Pituitrin causes a marked increase in the percentage and absolute amounts of chloride and a decrease in the amount of water eliminated. Substances of this type normally regulate the output of water and chloride in the intact animal, and the characters of the urine secreted by the isolated organ are due in large part to their absence.—F. **Eicholtz** and E. H. **Starling**: The action of inorganic salts on the secretion of the isolated kidney. Calcium working on a background of potassium leads to an increase of chloride excretion and water output, due to decreased re-absorption in the tubules. These salts, if given separately, have no definite effects. Inorganic phosphates decrease the output of water and chlorides by turning the calcium ion into a colloidal form. To this colloidal form the glomerulus membrane is impermeable. Cyanide increases the permeability of the glomerulus membrane and allows the colloidal phosphates to appear in the urine.—G. V. **Anrep**: A new method of crossed circulation. The method consists in an arterial anastomosis between a heart-lung preparation and the descending aorta or the brachiocephalic artery of another animal. Thus the part of the animal connected with the heart-lung preparation receives its blood supply from the latter, while the remaining part of the animal continues to be fed by its own heart. The blood flow and the blood pressure of the perfused part of the animal is therefore under complete control.—G. V. **Anrep** and I. de B. **Daly**: The output of adrenaline in cerebral anæmia, as studied by means of crossed circulation. In this condition there is an increased liberation of adrenaline from the suprarenal glands, which is due to a true secretion and not to redistribution of blood, and the increased secretion disappears after denervation of the suprarenal glands.—G. V. **Anrep** and E. H. **Starling**: Central and reflex regulation of the circulation. Mechanical rise in blood pressure in the brain inhibits the vasomotor centre and stimulates the cardio-inhibitory, the two centres acting synergetically to produce lowered pressure. Asphyxia by cerebral anæmia stimulates both vasomotor and cardio-inhibitory centres, the centres acting antagonistically, not synergetically. Andrenaline (small doses) introduced into head circulation causes slowing of heart and fall of pressure in lower half of animal. Measurement of pressure in Circle of Willis shows these effects are due to increased circulation through medullary centres, and cannot be ascribed to direct excitation of centres by adrenaline itself. The effects are analogous to, and produced in the same way as, those obtained on increasing pressure in head circulation.—K. **Furusawa**: Muscular exercise, lactic acid, and the supply and utilisation of oxygen. Part IX. Muscular activity and carbohydrate metabolism in the normal individual. Results obtained are: On normal diet, carbohydrate only is responsible for the process of contraction and recovery from it. As duration of exercise is prolonged respiratory quotient of excess metabolism falls slowly, indicating that some substance other than carbohydrate is being called upon. On fatty diet, short-lived muscular exercise is performed at expense only of carbohydrate, as on normal diet. In long-continued exercise, fat takes part more quickly than on normal diet. In exercise of short duration, in which no change in general metabolism of body as a whole might be expected, the human body acts as though it were an isolated muscle, in which carbohydrate is the only substance oxidised, as shown by Meyerhof. The primary fuel of contraction, therefore, in human muscle is carbohydrate, and fat or protein is presumably used to replenish carbohydrate store disappeared.—A. **Hunter** and J. A. **Dauphinee**: (1) Quantitative studies concerning the distribution of arginase in fishes and other animals. (2) An approximative colorimetric method for the determination of urea with an application to the detection and quantitative estimation of arginase.—J. J. R. **Macleod** and N. A. **McCormick**: The effect on the blood-sugar of fish of various conditions, including removal of the principal islets (isletectomy).

Royal Microscopical Society, January 21.—A. Chaston **Chapman**: The yeasts: a chapter in microscopical science (presidential address). Some new technique, such as the use of ultra-violet light, applied to the investigation of the cytology of the yeast cell, might, in the hands of expert cytologists, yield results equally valuable to industry and to general biology. The views of Cramer and others as to the dependence of intra-cellular enzymic activity on surface tension was referred to, and reasons were given for supposing these surface tension effects to be operative in connexion with some industrial fermentation processes. The yeast cell is, in fact, a chemical laboratory of the highest efficiency, and of the most remarkable character, and if the processes of building up and breaking down, which are so quietly and so regularly occurring in a single cell of yeast, could be understood and artificially imitated, we should be not only within measurable distance of a new organic chemistry, but also appreciably nearer to an understanding of that greatest of all problems, the nature of life.

Linnean Society, January 22.—Miss M. S. **Johnston**: Calcareous deposits (rhizocretions, Kindle) round roots of Canadian birches in Pleistocene sands. The concretion is considered to be due to the action of humic acid from the roots segregating the lime constituents in the sand.—R. D'O. **Good**: The flora of Canada. As in Britain, the largest plant families are the Compositæ, Gramineæ, Cyperaceæ, Leguminosæ, Rosaceæ, and Labiatæ, and the first named is very much larger than any of the others. In traversing the country from east to west, four main vegetational types are encountered: the Eastern forest, the prairie, the mountain, and the Pacific littoral. The southern limit of the Pleistocene ice was well down in the United States, and the present flora of Canada is therefore an immigrant flora developed in the geologically short time since the retreat of the ice.—J. **Munro**: Canadian forests and forestry. There are four climatic belts between the east coast and British Columbia.

CAMBRIDGE

Philosophical Society, January 19.—H. F. **Baker**: A transformation of Segre's figure in space of four dimensions; the equation of Kummer's surface. There is a figure, first studied by Stéphanos in the

theory of circles, but studied particularly by Segre as a figure in four dimensions, consisting of fifteen lines meeting by threes in fifteen points The figure is of great interest, as being the centre of a discussion of many well-known surfaces, the cubic surface, the cyclide, Kummer's surface, and so on In this figure there are also six sets of fives of the lines, each being taken twice over, called sets of *associated* lines The present paper finds a transformation from the lines of the figure to the joins of six points in space of *five* dimensions—a set of associated lines becoming the joins of one of the six points to the other five Intimately related therewith is the expression of the equation of a Kummer surface by a sum of five squares. The coefficients of these squares are invariants of the discriminantal equation of the primary quadratic complex.—R **Vaidyanathaswamy** On simplexes doubly incident with a quadric. The generalisation of the figure representing a double six of lines in five dimensions, wherein a hexad is both inscribed to and circumscribed about a quadric — H G **Green** The classification of conicoids by their generators An actual method of reduction of the equation of a conicoid to a form showing the character of the surface —R **Whiddington** On the positive flash in vacuum discharge tubes Moving striations previously observed in the rare gases were reinvestigated in the case of pure argon The bright flashes travelling from the anode with velocities depending on the pressure show no Doppler effect The luminous radiation seems to be excited by invisible radiation given out by positive ions as they travel along the tube —E C. **Stoner** The structure of radiation On the assumption of conservation of energy and linear momentum, the evidence in favour of radiation being constructed of linearly directed, spatially localised quanta is held to be conclusive Further properties, which are not physically unreasonable, must be postulated of these quanta in order that interference phenomena may be possible —Major P A **MacMahon** The symmetric functions of which the general determinant is a particular case

MANCHESTER

Literary and Philosophical Society, January 20 — W. **Robinson** On proliferation and doubling in the flowers of *Cardamine pratensis* L Specimens of *C pratensis* showing two main types of abnormality were found in meadows near Cheadle Hulme, Cheshire, in June 1923, one of which was similar to the double-flowered form, arising by proliferation of the ovary, described most frequently by previous observers, and the other, a less completely double-flowered specimen Microscopic investigation showed that, in both types, proliferation took place by the meristematic activity of a growing-point at the base of the ovary, of a flower which was otherwise normal In one case, however, the ovary itself was carried up on a stalk produced by the growth activity of tissues immediately below the base of the ovary, but outside this, in the other specimen all the growth took place within the ovary from the base of this, and the meristematic growing-point was carried up to about the middle of the pod-like structure The doubling seen in *C pratensis* has recently been spoken of as a mutation from the more normal single form, but Goebel has stated that by cultivating plants of the double form in sandy soil they completely lost the character. By vegetative multiplication from the original specimens collected wild at Cheadle Hulme, it has been possible to cultivate plants showing variations, both in the character and degree of the doubling Further work will show whether the plasticity of *C pratensis* is such that doubling can be produced under experimental conditions in a single-flowered form by nutritional changes as Goebel has suggested, or whether, as seems more likely, the double-flowered and single-flowered forms are two different races with distinct hereditary complexes

PARIS

Academy of Sciences, January 26 —G **Bigourdan**: The propagation of Hertzian waves to great distances. The order of magnitude of the perturbations of this propagation A table is given showing the results of the reception of the Bordeaux time signals for 1923, by Helwân (near Cairo), Washington, Ottawa, Greenwich, Paris and Uccle —H **Vincent** The urinary elimination of the *Bacillus coli communis* and its hæmatogen origin — P. **Bazy** Remarks on the preceding communication —Maurice **Lugeon** The presence of fossilised organic bodies in the marbles of Uruguay Fragments of echinoderms and molluscs have been recognised in marble from Nueva Carrara, this is of interest, as being the first occasion of the discovery of fossil remains in this crystalline deposit —Bertrand **Gambier** The continuous deformation of surfaces, isometry and applicability —Mlle Thérèse **Leroy** A new method for the determination of the working costs and a tariff for railway transport A new tariff scheme has been developed as the result of a mathematical study of data from eighty years' actual railway experience —**Andrieau** The Andrieau motor A detailed description of the mode of working, construction, and experimental results of a new design of internal combustion motor —Carl A **Garabedian** Solution of the problem of the heavy rectangular plate, framed or open, carrying a charge uniformly distributed or concentrated at its centre —A **Alayrac.** The theoretical study of motorless flight in a variable horizontal wind —Ernest **Esclangon** The eclipse of the sun of January 24, 1925, observed at the Strasbourg Observatory The time of first contact, deduced from two series of independent measurements of the chord of contacts, was $15^h\ 3^m\ 37^s$ —L **d'Azambuja** Observation of remarkable protuberances, made at the Meudon Observatory, January 24, 1925, before the eclipse of the sun On January 24 a series of spectroheliograms of the lines K_3 (calcium) and H_2 (hydrogen) was taken continuously A photograph taken at 11 10 A M with the calcium line showed the existence in the N W quadrant, of a fan-shaped group of protuberances in the form of jets, the largest of which attained a height of one-fifth of the solar radius Its development was very rapid, since photographs at 10 40 A M and 12 20 P M did not show it —J **Guillaume** and Mlle M **Bloch** Observation of the partial eclipse of the sun of January 24, 1925, made at the Lyons Observatory Clouds interfered with observations First contact was noted at $15^h\ 4^m\ 36^s.2$ — P **Chofardet** Observation of the eclipse of the sun of January 24, 1925, at the Besançon Observatory. Time of first contact at $15^h\ 3^m\ 48^s\ 8$ —F. **Holweck**: Determination of the critical potential L_{III} of argon. Discussion of the precision of this measurement and of analogous measurements —Ed **Friedel** Smectic bodies and X-rays The existence of a stage (smectic state) intermediate between the solid crystal and the true liquid has been indicated in an earlier communication for certain oleates These conclusions have been questioned, and additional experiments on the radiograms furnished by ethyl *p*-azoxy-benzoate, and ethyl azoxy-cinnamate have been made The results confirm the conclusions previously given — F **Baldet** The spectrum of carbon monoxide at very low pressure, the so-called comet-tail spectrum — Ernest **Bengtsson** and Erik **Svensson** The conditions

of the appearance and structure of the silver bands, λ3330 and λ3358 —F **Croze** The structure of the line spectra of ionised nitrogen and oxygen —Jean Jacques **Trillat** The molecular orientation of the fatty acids —Herbert **Brennen** Chemical studies on the isotopes of lead A partial separation of the isotopes of lead by the action of the Grignard reagent on lead chloride has been recently described by Dillon, Clarke, and Hinchy This work has been repeated, and no evidence of separation of isotopes was obtained —Georges **Fournier** The absorption of the β-rays by matter If μ is the coefficient of absorption and ρ the density of the material, then experiments with six materials show that the relation $\mu/\rho = a + b\mathrm{N}$ (where N is the atomic number) is valid —A **Bigot** Clays, kaolins, etc —L **Blanc** and G **Chaudron**. The magnetic study of the stable form of the sesquioxides of iron and chromium The magnetic susceptibility of Fe_2O_3 and Cr_2O_3 as a function of the temperature is given in graphical form the results are difficult to interpret André **Graire** The reduction of the oxides of nitrogen in the presence of sulphuric and sulphurous acids — Marcel **Godchot** and Pierre **Bedos** The chlorination of para-methyl-cyclohexanone —Ch **Courtot** and P **Petitcolas** Syntheses of 9-fluorenylamines — J **Barthoux** Description of a new mineral, dussertite This mineral, found at Djebel Debar, is an arsenate of the composition $(FeAl)_3(CaMg)_3(OH)_9(AsO_4)_2$ The full chemical analysis, physical and mineralogical description are given —Pierre **Bonnet** The problem of the Trias of the Avallonnais and Auxois —Pierre **Dangeard** Limits of the submerged plant growth of Lake Annecy at varying depths —P **Mazé** The plurality of the products of photosynthesis, deduced from the study of the gaseous exchanges between the atmosphere and the whole plant —Mlle Sara **Bache-Wug** The vacuome of *Erysiphe graminis* —P E **Pinoy** Concerning the cancer of plants or crown gall L **Ravaz** and G **Verge** A disease of the vine, excoriosis —Mme Jean **Francois-Perey** The influence of the culture medium on protozoa counts in soil The influence of the culture medium is marked, an extract of the earth with gelose is recommended as giving the most trustworthy results —C F **Muttelet** Study of the development of the pea, from the point of view of conservation for food —Vittorio **Pettinari** The toxic action of *Amanita phalloides* —Georges **Bourguignon** and J B S **Haldane** The evolution of chronaxy in the course of the crisis of experimental tetany by voluntary hyperpnea in man —A **Malaquin** The segregation, in the course of ontogenesis, of two primordial sexual cells, origin of the germinal descent in *Salmacina Dysteri* —Robert **Weill** Foci of formation and ways of migration of the nematocysts of *Halyclistus octoradiatus* The existence, along their path, of selective reservoirs —J **Chaine** Remarks on the penian bone —Armand **Dehorne** The petaloid expansions of the leucocytes of the Chetopoda The case of *Leydenia Gemmipara* —Ph **Joyet-Lavergne** The lipoids and fats of the Sporozoa —Edouard **Chatton** and André **Lwoff** The physiological determinism of the phases of the cycle of the infusorian *Spirophrya subparasitica* —A **Berthelot** and G **Ramon** The agents of transformation of the toxins into anatoxins Toxins can be converted in various ways into substances deprived of toxic power, but retaining the power of flocculation (*in vitro*) and immunising power (*in vivo*) These products are described as anatoxins, and the action of a large number of chemical compounds on the diphtheria toxin has been studied from this point of view The most effective reagents for the production of the diphtheria anatoxine proved to be acrolein, crotonaldehyde, acetaldehyde and hexamethylenetetramine

Official Publications Received.

Department of the Interior United States Geological Survey Bulletin 751-E The Scobey Lignite Field Valley, Daniels, and Sheridan Counties, Montana By Arthur J Collier Pp v + 157-230 + plates 21-29 (Washington Government Printing Office)

Department of the Interior United States Geological Survey Professional Paper 132-F Relations of the Wasatch and Green River Formations in North-Western Colorado and Southern Wyoming, with Notes on Oil Shale in the Green River Formation By J D Sears and W H Bradley Pp ii+93 107+2 plates Professional Paper 132-G. Discovery of a Balkan Fresh-water Fauna in the Idaho Formation of Snake River Valley, Idaho By W H Dall Pp ii+109-115+1 plate Professional Paper 132-H The Resuscitation of the Term Bryn Mawr Gravel By F Bascom Pp 117-119 (Washington. Government Printing Office)

"The First Five Thousand" being the First Report of the First Birth Control Clinic in the British Empire, "The Mothers' Clinic" for Constructive Birth Control at 61 Marlborough Road, Holloway, London, N 19 By Dr Marie Carmichael Stopes Pp. 67 (London J Bale, Sons and Danielsson, Ltd) 2s 6d net

Department of Commerce U S Coast and Geodetic Survey Serial No 260 Precise Triangulation, Traverse and Leveling in North Carolina By Walter D Sutcliffe and Henry G Avers (Special Publication No 101) Pp iv+184 (Washington Government Printing Office) 25 cents

Annuaire de l'Observatoire Royal de Belgique Par P Stroobant 93me annee, 1926 Pp iii+154 (Bruxelles)

The Physical Society of London Proceedings, Vol 37, Part 2 February 15 Pp 75-100+50 D (London Fleetway Press, Ltd) 6s net

Thirty-eighth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1916-17, with accompanying Paper, An Introductory Study of the Arts, Crafts and Customs of the Guiana Indians, by Walter Edmund Roth Pp vii+745+188 plates (Washington Government Printing Office) 3 dollars

State of Illinois Department of Registration and Education Division of the Natural History Survey Bulletin, Vol. 15, Art 3. Second Report on a Forest Survey of Illinois, The Economics of Forestry in the State. By Herman H Chapman and Robert B Miller Pp vii+46-172 (Urbana, Ill)

Iowa Geological Survey Vol 29 Annual Reports, 1919 and 1920, with Accompanying Papers Pp xlviii+568+54 plates (Des Moines)

University of Iowa Studies in Natural History Vol 10, No 5 Fiji-New Zealand Expedition Narrative and Preliminary Report of a Scientific Expedition from the University of Iowa to the South Seas By C C Nutting, with Chapters on Ornithology and Entomology by Dayton Stoner, on Botany by R B Wylie, and on Geology by A O Thomas. Pp 369+58 plates (Iowa City) 3 dollars

Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information, 1924 Pp iv+400+50 (London H M Stationery Office) 10s 6d net

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 50 A Third Bioclimatic Study in the Egyptian Desert. By C B Williams Pp ii+82+7 plates (Cairo Government Publications Office) 5 P T

Memoirs of the Department of Agriculture in India Chemical Series, Vol 7, No 6 Studies in the Chemistry of Sugarcane 2 Some Factors that determine the Ripeness of Sugarcane By D Viswanath and S Kasinatha Ayyar Pp 123-144 (Calcutta Thacker, Spink and Co, London W Thacker and Co) 8 annas, 9d

Western Australia. Annual Progress Report of the Geological Survey for the Year 1923 Pp 38+3 plates (Perth Fred Wm Simpson)

Department of the Interior Bureau of Education Bulletin, 1924, No 19 Schools for Adults in Prisons, 1923 By A C Hill Pp iii+33 (Washington Government Printing Office) 5 cents

Diary of Societies.

SATURDAY, MARCH 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30

ASSOCIATION OF TECHNICAL INSTITUTIONS (Annual Meeting) (at Institution of Mechanical Engineers), at 11 A M —Lord Emmott and Ppl W M Varley The Local College and its Relation to Surrounding Education Authorities —G Mavor Training and Education for Apprenticeship —J E Montgomery The Working of the Schemes for National Certificates and Diplomas in Engineering

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern and South Midland Districts) (at Town Hall, Ealing), at 2 35 —The Question of Regional Town Planning

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford The Counting of the Atoms (II)

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich) —Dr F. W Crossley-Holland Science and the Criminal.

MONDAY, MARCH 9.

ROYAL SOCIETY OF EDINBURGH, at 4 30 —A H R Goldie Discontinuities in the Atmosphere —Dr A P Laurie Stone Decay and the Preservation of Buildings (Address) —W H Watson An Investigation of the Absorption of Superposed X-Radiations —H W Turnbull and J Williamson The Minimum System of Two Quadratic Forms —Prof H S Allen Note on Whittaker's Quantum Mechanism —Marion C Gray The Equation of Conduction of Heat

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 — Rev C Gardner Nature and Supernature

BIOCHEMICAL SOCIETY (at Lister Institute), at 5 —F W Fox The Cholesterol Content of Bile and its Bearing upon the Metabolism of Cholesterol and the Bile Acids —J R Marrack The Total Base Content of Plasma —D Hoffert and I S MacLean The Action of Yeast on Lactic Acid —E H Lepper and C J Martin (a) The Influence

of Salt Concentrations on the C_H of Buffer Solutions as indicated by the Electrometric and Colorimetric Methods respectively, (b) Can the C_H of Mixtures of $NaHCO_3$ and CO_2 in High Dilutions be determined by the Hydrogen Electrode?

Royal Society of Medicine (War Section), at 5.—Presentation, by Sir St Clair Thomson, of the North Persian Forces Memorial Medal for 1923 to Wing-Commdr H E Whittingham, for his Paper, Observations on the Life-History and Bionomics of *Phlebotomus papatasii*, written in conjunction with Flight Lieut A F Rook.—Wing-Commdr H E Whittingham The Treatment of Malaria by Novarsenobillon

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College, Newcastle-on-Tyne), at 7 15.—Major E I David Electricity in Mines

Institute of Chemistry (Birmingham Section) (at White Horse Hotel, Birmingham), at 7 30.—G W Marlow Chemists' Agreements.

Institute of Metals (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7 30.—A G Lobley Electric Furnaces

Society of Chemical Industry (London Section) and Institute of Chemistry (London and South-Eastern Counties Section) (at Institution of Mechanical Engineers), at 8.—Sir Max Muspratt, Bart Chemistry and Civilisation

Surveyors' Institution, at 8

Royal Geographical Society (at Æolian Hall), at 8 30.—A F R Wollaston The Sierra Nevada of Santa Marta, Colombia.

Medical Society of London, at 8 30.—E Clarke, A. F. Moore, Dr J Collier, and others Discussion on The Fundus Oculi in General Medicine

Ipswich and District Natural History Society (at Ipswich).—Dr F W Crossley-Holland Science and the Criminal

TUESDAY, March 10

Royal College of Physicians of London, at 5.—Dr S MacNalty Epidemic Diseases of the Central Nervous System (Milroy Lectures) (II)

Royal Institution of Great Britain, at 5 15.—Prof E N da C Andrade The Evolution of the Scientific Instrument (I)

Institution of Petroleum Technologists (Annual General Meeting) (at Royal Society of Arts), at 5 30.—H Barringer Address

Institution of Civil Engineers, at 6.—Prof S M Dixon and F W Macaulay Measurements of Discharge over a Rock-faced Dam

Institution of Automobile Engineers (at Royal Society of Arts), at 7

Institution of Electrical Engineers (Informal Meeting), at 7.—C W. Sully and others Discussion on Illumination

Institution of Electrical Engineers (North Midland Centre) (at Bradford Technical College), at 7.—H W Taylor Three-wire Direct-current Distribution Networks Some Comparisons in Cost and Operation

Institution of Electrical Engineers (Scottish Section) (at North British Station Hotel, Edinburgh), at 7.—E Hughes Iron Losses in D C Machines

Royal Photographic Society of Great Britain, at 7.—Annual General Meeting

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7 30.—G A Whiteman and A Spittle The Manufacture of Brass Condenser Tubes, with some Notes on an Alternative Alloy

Institution of Automobile Engineers (Coventry Graduates' Meeting) (at Broadgate Café, Coventry)

WEDNESDAY, March 11

Institute of Metals (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 a m.—H T Angus and P F Summers The Effect of Grain-size upon Hardness and Annealing Temperature.—S L Archbutt A Method of Improving the Properties of Aluminium Alloy Castings.—U R Evans Surface Abrasion as a Potential Cause of Localised Corrosion.—Dr J Newton Friend and J S Tidmus The Influence of Emulsoids upon the Rate of Dissolution of Zinc in Solutions of Lead, Nickel, and Copper Salts.—At 2.—T G Bamford Comparative Tests on some Varieties of Commercial Copper Rod.—R Genders and G L Bailey The Alpha Phase Boundary in the Copper-Zinc System.—Dr D. Bunting. The Influence of Lead and Tin on the Brittle Ranges of Brass.—E A Bolton The Removal of Red Stains from Brass

Geological Society of London, at 5 30.—Prof O T Jones The Geology of the Llandovery District (Carmarthenshire).—G Andrew The Llandovery and Associated Rocks of Garth (Breconshire).—G Andrew and Prof O T Jones The Relations between the Llandovery Rocks of Llandovery and those of Garth

Institution of Civil Engineers (Informal Meeting), at 7.—J S Wilson The Relative Importance and Nature of Secondary Stresses in Steel Structures.

Institution of Electrical Engineers (South Midland Centre) (at Birmingham University), at 7.—Major E I David Electricity in Mines.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle-on-Tyne), at 7.—G R Hutchinson Some Problems of the Motor Ship

Royal Society of Arts, at 8.—E Cammaerts The Restoration of Public Buildings in Belgium

Institution of Chemical Engineers (at Institution of Mechanical Engineers), at 8.—Prof A L Mellanby Expansion and Compression Phenomena in Steam Jets

Institution of Automobile Engineers (North of England Centre) (at Leeds).

THURSDAY, March 12

Institute of Metals (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 a m.—G L Bailey and R. Genders The Density and Constitution of the Industrial Brasses.—A L Norbury The Effects of certain Elements on the Electrical Resistivity of Copper.—Sir Thomas Kirke Rose The Density of Rhodium.—Prof T Honda and Prof R Yamada Some Experiments on the Abrasion of Metals.—Prof T Ishara The Equilibrium Diagram of the Aluminium-Zinc System

Royal Society, at 4 30.—Sir Charles Sherrington Remarks on some Aspects of Reflex Inhibition.—E G. T Liddell and Sir Charles Sherrington Recruitment and some other Features of Reflex Inhibition.—D. T Harris Studies on the Biological Action of Light.—Dr H Hartridge and F. J W Roughton The Kinetics of Hæmoglobin III.—*To be read in title only*.—S B Schryver, H W Buston, and D H Mukherjee The Isolation of a Product of Hydrolysis of the Proteins hitherto undescribed

Royal College of Physicians of London, at 5.—Dr S MacNalty Epidemic Diseases of the Central Nervous System (Milroy Lectures) (III)

Royal Institution of Great Britain, at 5 15.—Dr L Hill The Biological Action of Light (I)

Royal Society of Medicine (Comparative Medicine, Tropical Diseases, and Obstetrics Sections), at 5 30.—Special Discussion Infective Abortion in Cattle and its Relation to Mediterranean Fever

Institution of Electrical Engineers (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7 15.—H W Taylor Three-wire Direct current Distribution Networks Some Comparisons in Cost and Operation

Institution of Electrical Engineers (Irish Centre (Dublin)) (at Trinity College, Dublin), at 7.45.—Dr J F Crowley The Use of Electricity in the Chemical Industries, with particular reference to the Irish Free State

Institute of Chemistry (Liverpool and North Western Section) (at Liverpool University), at 8.—Prof E C C Baly A Lecture Tour in America

FRIDAY, March 13

Royal Astronomical Society, at 5.—G Prasad The Progression of Stellar Velocity with Absolute Magnitude.—Dr J W Nicholson The Secondary Spectrum of Hydrogen.—Dr H Jeffreys The Origin of the Solar System, in relation to Prof Eddington's Theory of Stellar Luminosity.—E A Kreiken The Density Function in the Milky Way.—Dr J K Fotheringham Visibility of Stars in Great Britain during the Solar Eclipse of 1925, Jan 24.—T. Royds Note on Spectroheliograms taken with Different Parts of the Hα line.—S D Tscherny (a) Results of Micrometer Measures of the Position of Mars relative to the Star B D −4° 5913 on 1924, Dec 5, (b) Occultations of Stars by the Moon, 1924

Physical Society of London (at Imperial College of Science and Technology), at 5.—J P Andrews The Variation of Young's Modulus at High Temperatures.—Dr E G Richardson The Critical Velocity of Flow past Objects of Aerofoil Section.—Dr J Brentano A Focussing Method of Crystal Powder Analysis by X-rays

Institution of Mechanical Engineers, at 6.—Reports to the Cutting Tools Research Committee.—Prof E G Coker The Action of Cutting Tools.—D Smith and A Leigh Experiments with Lathe Tools on Fine Cuts, and some Physical Properties of the Tool Steels and Metal operated upon

Royal Photographic Society of Great Britain, at 7.—F Judge Many Slides and a few Remarks

Institute of Metals (Swansea Local Section) (at Swansea University College), at 7 15.—General Discussion

Junior Institution of Engineers, at 7 30.—A P Bale Notes on Methods of Producing Modern High Grade Machine Tools

North-East Coast Institution of Engineers and Shipbuilders (at Literary and Philosophical Society, Newcastle-on Tyne), at 7 30

Royal Institution of Great Britain, at 9.—Prof Gilbert Murray The Beginnings of the Science of Language

SATURDAY, March 14

Royal Institution of Great Britain, at 3.—Sir Ernest Rutherford The Counting of the Atoms (III)

PUBLIC LECTURES.

SATURDAY, March 7

Horniman Museum (Forest Hill), at 3 30.—Miss M A Murray Modern Excavations in Egypt

MONDAY, March 9

Bedford College for Women, at 5 15.—Prof L Lévy-Bruhl Trois Philosophes français contemporains Ribot, Espinas, Durkheim (in French) (Succeeding Lectures on March 10, 13)

University College, at 5 30.—Prof H Westergaard Vital Statistics. (Succeeding Lecture on March 11).—Miss E Jeffries Davis Some Famous London Bridges (I) (Succeeding Lectures, by Prof A E Richardson, on March 16, 23)

Inner Temple Hall, at 8.—Lord Newton The Necessity for Legislation with regard to Smoke Abatement (Chadwick Lecture)

TUESDAY, March 10

University College, at 5 30.—R A Smith The Old Stone Age

University of Leeds, at 8.—E Percival The Freshwater Zoology of Yorkshire (I)

WEDNESDAY, March 11

School of Oriental Studies, at 5 15.—E Richmond Early Moslem Architecture The Early Madrassas in Syria, Bagdad, Egypt up to end of Ayyubi Dynasty Developments during the Mamluke Period up to the Turkish Conquest.

King's College, at 5 30.—Prof E Prestage Travel and Travellers of the Middle Ages (IX) The Opening of the Ocean Routes, A D 1415-60

University College, at 5 30.—Miss Ethel S Fegan Library Resources outside London

THURSDAY, March 12

University College, at 5.—Prof E. A Gardner History of Ancient Sculpture (Introductory Lecture).

SATURDAY, March 14

Horniman Museum (Forest Hill), at 3 30.—Dr R L Sherlock Man as a Geological Agent

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Electric Forces and Quanta.[1]

By J H. JEANS, Sec. R S

IT is just about twenty-five years since Lord Kelvin spoke of "two clouds" obscuring "the beauty and clearness of the dynamical theory which asserts light and heat to be two modes of motion" The clouds which Lord Kelvin saw as clouds no bigger than a man's hand have grown until they have almost filled the firmament: little can now be seen of the beauty and clearness of the dynamical theory of which Lord Kelvin spoke The old dynamical theory has given place to the new theories of relativity and of quanta, what Lord Kelvin thought were transient clouds shortly to melt away have proved to be new theories in process of growth, the "beauty and clearness" he saw under these clouds was mostly a mirage.

I have chosen as my title "Electric Forces and Quanta," the two halves of this title corresponding roughly to the two new theories, and I propose to try to sketch out the changes these theories have introduced into our conception of fundamental electrical processes Let us consider electric forces first Lord Kelvin, following Maxwell and Faraday, regarded an electric force as evidence of a stress in the ether. An ether can transmit two kinds of stress, one arising from a state of static strain and the other from a transfer of momentum, these were supposed to be electric and magnetic forces respectively. Or, to put the matter in another way, an ether can possess two kinds of energy, potential and kinetic, these were identified with electrostatic and electromagnetic energy respectively This mechanism of stresses in the ether was devised in order to escape the necessity of "action at a distance." The ether itself had no doubt originally been brought into existence for quite other reasons—to provide a nominative to the verb "to undulate," according to the late Lord Salisbury—but these other reasons were no longer of much cogency Light, whether an undulation of a medium or not, was admittedly an electromagnetic phenomenon, and the electromagnetic theory of light had already made it clear that any mechanism which could account satisfactorily for electric and magnetic forces could carry the whole of the undulatory theory as well. It was because Maxwell and Faraday had disliked "action at a distance" that the ether continued in existence at the end of the nineteenth century

A MEDIUM OR ACTION AT A DISTANCE

Nevertheless, the conception involved a difficulty which seems to have troubled the nineteenth-century physicists not a little The energy of the ether could represent all kinds of electromagnetic energy, but could represent nothing else Gravitational energy, for example, could not be interpreted as ethereal energy, for the only two types of energy which the ether could hold were already allotted to electric and magnetic energy respectively It is true that attempts were made to interpret gravitation as normal waves of compression or as pulsations of very high frequency in the luminiferous ether, but such explanations never survived comparison with facts, and those who tried to explain gravitation had to fall back either on a new and entirely separate ether or else on action at a distance. If action at a distance had to be called in to explain gravitation, it might just as well be allowed to explain electromagnetism as well, there seemed to be no logical resting-place between two ethers and none But the need for multiple ethers simultaneously filling space aroused suspicions in those who were conversant with the history of science In an earlier century, according to Sir Joseph Larmor, "aethers were invented for the planets to swim in, to constitute electric atmospheres and magnetic effluvia, to convey sensations from one part of our bodies to another, and so on, till all space had been filled three or four times over with aethers It is only when we remember the extensive and mischievous influence on science which hypotheses about aethers used formerly to exercise, that we can appreciate the horror of aethers which sober-minded men had during the eighteenth century"

In time it became clear that the only thoroughly satisfactory possibility was no ether at all First the development of the theory of relativity gave its death-blow to the old luminiferous ether of Lord Kelvin, Maxwell, and Faraday. The main result of this theory can be stated in the form that all the phenomena of Nature go on precisely as though there were no ether.

[1] The Sixteenth Kelvin Lecture, delivered on February 5 at the Institution of Electrical Engineers

This does not of course abolish the ether, it shows the conception of an ether to be superfluous and perhaps even a little bit ridiculous—for it is ridiculous to fill the whole of space with a medium and then agree that everything goes on just as if the medium were not there—but it does not show it to be illogical.

The Existence of an Ether.

To the question, "Does an ether exist?" science is still unable to give a definite answer The question, "Does the ether exist?" if the ether is taken to mean the luminiferous ether of Maxwell and Faraday, ought almost certainly to be answered in the negative Speaking for a moment in the language of technical mathematics, the reason is that all the phenomena of Nature are invariant to the Lorentzian transformation (the transformation to axes moving with a uniform velocity), whereas the physical properties allotted to the ether by Maxwell and Faraday are not invariant Let E and H denote the electric and magnetic force at a point in the supposed ether, then E^2-H^2 (the integrand in the action integral) is invariant, so that all properties which follow from the principle of least action are independent of the motion of the observer These are of course the dynamical properties of the system But E^2+H^2 is not invariant, so that the phenomena which follow from attributing energy to the ether at a rate $(1/8\pi)(E^2+H^2)$ per unit volume are not the same for a moving observer as for a stationary one.

Of the six components of stress attributed by Maxwell to the ether, only three are invariant, so that electromagnetic phenomena, if explained in terms of ether stresses, call for stresses which are not the same for a moving observer as for one at rest even though the observed phenomena are absolutely identical For example, if magnetic forces are of ethereal origin, then the forces observed by a moving observer must be of quite different nature and origin physically from those observed by an observer at rest If the latter observer's forces are produced by Maxwell's mechanism, the former's cannot be To take the simplest example: an observer moving through a stationary electrostatic field will in actual fact observe magnetic forces just as much as if the field moved past him, yet the ether at every point of his path possesses no kinetic energy and so, according to the Maxwell-Faraday conception, could show no magnetic forces The old Maxwell-Faraday ether had in some way to provide a duplicate mechanism for a single phenomenon, the magnetic force arising from an electric charge—and similarly for most other phenomena No one has ever shown that it is capable of doing this, but even if they had, the duplication of mechanism to produce a single phenomenon is so contrary to the usual workings of Nature that there is not much risk in dismissing the old ether to the lumber-room

Thus we may be confident that if an ether exists, it must be something very different from the Maxwell-Faraday ether It must probably be thought of as a four-dimensional structure and must be more subjective than the Maxwell-Faraday ether Each of us must carry his own ether about with him, extending through all space and all time, much as in a shower of rain each observer carries his own rainbow about with him Whether such a structure, if it exists, ought to be called an ether, others must decide.

We may remark in passing that the conception of an ether has always made a special appeal to the practical, one might almost say engineering, type of mind which we associate with the leaders of British science. While our own physicists have asked for Nature to be reduced to a machine transmitting tensions and stresses, the more metaphysical minds of the Continent have usually been content to accept action at a distance as an ultimate explanation of natural phenomena, or at least to regard such an explanation as being in every way as final and as satisfying as an explanation in terms of a medium It was something more than a coincidence that Newton, Kelvin, Clerk Maxwell, and Faraday were all British, while Boscovitch, Einstein, and Weyl are not

Four-dimensional Geometry

The paper which practically abolished the ether as a serious scientific hypothesis was published by Einstein in 1905. Ten years later he published a second paper which may be said to have shown us how to get on without either an ether or action at a distance His first paper, as afterwards interpreted by Minkowski, had shown that all the phenomena of electromagnetism might be thought of as occurring in a continuum of four dimensions—three dimensions of space and one of time—*in which it is impossible to separate the space from the time in any absolute manner* You may separate them in one way, but you will find that I separate them differently, and in the end we shall both agree that no objective separation is possible.

Einstein's second paper showed that the phenomena of gravitation could be explained on the supposition that the geometry of this four-dimensional continuum was not of the ordinary Euclidean type. The continuum was supposed to be affected by kinks and twists in the neighbourhood of gravitating masses, and it was these, and not a "gravitational force," that threw a particle out of a straight course. It became just as inaccurate to say that the sun attracts the earth as to say that a bowl on an uneven bowling green is attracted or repelled by the other bowls In this curved space

the path of a particle is always a geodesic—the most direct distance between two points—and this may have very different properties from a Euclidean straight line

We must, of course, remember that the paths we are discussing are in a four-dimensional space—if we were speaking of ordinary paths in three-dimensional space, it would clearly be ridiculous to say that the curved orbit of a planet provided the most direct path from perihelion to aphelion, it is only when we allow for the motion in time as well as in space that the statement becomes reasonable We can get rid of most of the motion in time by supposing our planet, or other body, to move with enormously high velocity, and then the path described actually approximates to a straight line, which is now the most direct path even in three-dimensional space

We can gain some conception of the main features of Einstein's geometry from the analogy of spherical geometry, the curved surface of our earth provides a fair two-dimensional analogy to Einstein's curved four-dimensional space To one who thinks in terms of "parallels" of latitude and longitude, or who studies geography on a Mercator chart, the most direct course on our earth's surface looks oddly curved it is always a surprise to the unsophisticated traveller that the ship taking him from Southampton to New York (say from A to B in Fig 1) turns a bit to the north on rounding the Lizard, while the great circle course on the ship's chart (AECB in Fig 1) looks very much as if the ship were describing an orbit about a centre of attraction in the middle of the Sahara

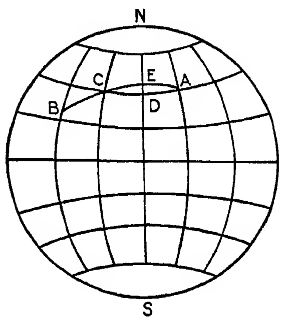

Fig 1

If Einstein was able to avoid the evils both of action at a distance and of an ether in the gravitational problem, there would seem to be no reason why they should not be similarly avoided in the electromagnetic problem which specially interests us to-night Not only is there no reason why this should not be done, it actually has been done. In 1918 Weyl pointed out that the geometry of Einstein was not the most general geometry which conformed to the relativity condition Space could be distorted still further in ways unimagined by Einstein, these further distortions of the four-dimensional space being specified by the six components of a vector Now the significant thing is this On calculating the relations which must hold between the six components of the vector in order that the relativity condition may be satisfied, Weyl finds equations which are precisely identical with the electromagnetic equations of Maxwell, the six components in question now appearing as the three components of electric force and the three components of magnetic force

Weyl's Electromagnetic Theory

It is not easy to explain in non-mathematical language what is the essential difference between Weyl's space and the old Euclidean space We can best attempt it by treating Einstein's space as a half-way house Returning for a moment to the two-dimensional analogy provided by the earth's curved surface, we know that the length of a degree of longitude decreases as we recede from the equator, the ship turns north on its voyage from the Lizard to New York in order to take advantage of the shorter degrees of longitude up north The planet going round the sun describes a curved path for a similar reason According to Einstein's theory, a measuring rod changes in length as it moves about in a gravitational field—a two-foot rule is no longer two feet in length if taken from the earth to the sun; it is because of this that the wave-length of the light represented by a definite spectral line when emitted at the sun's surface is different from that of the same light emitted on earth. The length of the rod depends only on its distance from the sun, being, in fact, proportional to

$$\left(1-\frac{2\gamma m}{rc^2}\right)^{-\frac{1}{2}},$$

where γ is the gravitation constant, m the mass of the sun, c the velocity of light, and r the distance from the sun But in Weyl's space the length of such a rod does not depend solely on its position it depends also on the path by which this position has been attained. A rod of length l displaced parallel to itself through a distance dx, dy, dz, dt in the four-dimensional continuum may be supposed to experience a change of length dl defined by

$$dl = l(F dx + G dy + H dz - \Psi dt),$$

where F, G, H, Ψ are quantities which need not at present be specified If the rod is taken a journey from P to Q its whole change of length will be given by

$$\log\frac{l_q}{l_p} = \int_P^Q (F dx + G dy + H dz - \Psi dt)$$

In Einstein's geometry the integrand is necessarily a perfect differential, so that the value of l_q/l_p depends only on the position of Q and P and not on the particular path selected from P to Q, the condition that this integrand shall be a perfect differential is expressed by the six equations

$$\frac{\partial H}{\partial y}-\frac{\partial G}{\partial z}=0, \qquad -\frac{\partial \Psi}{\partial x}-\frac{\partial F}{\partial t}=0,$$
$$\frac{\partial F}{\partial z}-\frac{\partial H}{\partial x}=0, \qquad -\frac{\partial \Psi}{\partial y}-\frac{\partial G}{\partial t}=0,$$
$$\frac{\partial G}{\partial x}-\frac{\partial F}{\partial y}=0, \qquad -\frac{\partial \Psi}{\partial x}-\frac{\partial H}{\partial t}=0$$

In Weyl's geometry, on the other hand, the integrand $Fdx+Gdy+Hdz-\Psi dt$ is not a perfect differential, so that the quantities on the left hand of the equations just written down do not vanish, they have values a, b, c, X, Y, Z different from zero, so that

$$\frac{\partial H}{\partial y}-\frac{\partial G}{\partial z}=a, \qquad -\frac{\partial \Psi}{\partial x}-\frac{\partial F}{\partial t}=X,$$
$$\frac{\partial F}{\partial z}-\frac{\partial H}{\partial x}=b, \qquad -\frac{\partial \Psi}{\partial y}-\frac{\partial G}{\partial t}=Y,$$
$$\frac{\partial G}{\partial x}-\frac{\partial F}{\partial y}=c, \qquad -\frac{\partial \Psi}{\partial z}-\frac{\partial H}{\partial t}=Z$$

These are precisely Maxwell's electromagnetic equations, F, G, H being the components of the magnetic vector potential, and Ψ the electrostatic potential Turning back, we see that F, G, H, and Ψ are determined at any point by the rate at which a measuring rod of unit length changes its length as it passes through that point

When Einstein explained gravitation in terms of curvatures and special metric properties of space, the equations of his theory were found to be different from those of the old Newtonian theory It was accordingly possible to make an observational test between the two theories, and this decided immediately and conclusively in favour of the theory of Einstein There is no hope of establishing the truth of Weyl's theory in a similar way, for, as we have just seen, the equations to which it leads are precisely identical with the already universally accepted equations of Maxwell Weyl's theory can only be judged by its inherent plausibility or the reverse

Judged by this standard, everything seems to be in its favour The luminiferous ether failed, partly because it left no room for gravitation, partly because its mechanism had to be supposed to be too elaborate for the facts to be explained The hypothesis of an ether led us to anticipate a whole series of different phenomena corresponding to different velocities through the ether, so that when these were not forthcoming, its advocates were compelled to elaborate a complicated theory by which all the forces of Nature were in collusion to make these different occurrences appear the same to us The Einstein-Weyl geometrical theory escapes both these reproaches Both gravitation and electromagnetism fit perfectly naturally into their places These two systems of forces correspond exactly and completely to the ways in which a four-dimensional geometry can differ from the simple geometry of Euclid The observed forces of gravitation and electromagnetism correspond exactly to the most general forces which are possible, if "force" is interpreted simply as an illusion arising from a crumpling up of space Consequently the observed phenomena of Nature are precisely those which ought to be observed —not one is missing and neither is there room for a single one more. There is now no collusion among the forces of Nature to conceal a whole series of unobserved phenomena indeed, there could be no concealment because there is nothing to conceal By its simplicity, its completeness, and its perfect agreement with the observed phenomena of Nature, the theory seems likely to take its place as our final interpretation of the "forces" of Nature

We now see that the universe of Euclid, in which parallel lines never meet and in which two sides of a triangle are always greater than the third, was a simplified ideal universe. In the same way the universe of Aristotle and Plato, in which space and time are permanently distinct and essentially different in their natures, was a simplified ideal universe Both universes were too simple to fit the facts, remove the unwarranted simplifications and we are left with a universe the geometrical properties of which are expressed by such equations as Einstein's gravitational equations (to which Newton's inverse square law gives a good approximation) and Maxwell's electrodynamical equations Thus geometry, cleared of *all* unjustifiable assumptions, transforms itself into mechanics, both gravitational and electrodynamical A being who was born without any one of his five senses, but with unlimited geometrical reasoning powers, could deduce the general nature of the actual world without any experience of reality he would anticipate that landslides, earthquakes, thunderstorms, and auroræ would occur, but he would know nothing about "forces," and would regard these phenomena merely as geometrical necessities

Atomicity

Although generalised geometry can predict and explain all the systems of forces of the universe, it has its limitations, there are features of the actual universe before which it stands powerless. Nothing in geometry can explain the essential differences between positive and negative electricity, or the atomicity of electric charges, so that the whole inner structure of matter, including the whole of chemistry, would be outside the scope of the intuitions of our supposed geometer.

Electric charges are a consequence of, or at least are associated with, a curving or crumpling of space, but so far as pure geometry goes there is no restriction on the extent of this crumpling, so that our geometer, reasoning from geometry alone, might expect to find charges of all possible amounts, whereas in actual fact

electric charges occur only in multiples of a definite unit, the charge of an electron It is clear, then, that there is something more than geometry underlying the phenomena of Nature, the whole phenomenal universe may be geometry with restrictions if we like, but not merely the geometry which is obtained by generalising the geometry of Euclid until we can generalise no further Space can be crumpled up qualitatively in all the ways known to geometry but not quantitatively, the uniformity of the electronic charge must in some way represent an absolute restriction on the measure of the crumpling

Each particle of matter—each electron, let us say—occupies one point of space at any one instant of time, and the succession of these points will form a line in the four-dimensional space-time continuum—the "world-line" of the electron In the neighbourhood of this world-line there is a deformation of the continuum due to the existence of the electron

The near approach of two electrons or of any two charged particles is represented by a near approach of their world-lines in the four-dimensional continuum Each world-line is surrounded by its associated deformation, and in regions in which the world-lines are near to one another the adjacent regions of the continuum will be doubly deformed

A priori there are two possibilities open The first is that the two deformations are merely additive, just as, when two ships approach, each making its own wash (or deformation of the surface of the sea), the height of wash at any point is the sum of the heights of the washes made by the two ships independently The second possibility is that, as there have been found to be restrictions on the amount of deformation associated with the two separate world-lines, there may be a further restriction on the deformation arising from their combination.

In actual fact the former alternative appears to prevail when one or both of the charged particles are "free" electrons, but the latter alternative when they are "bound" together; that is, when they are permanently describing orbits about one another It is these latter restrictions that have given rise to the theory of quanta Just as the restrictions associated with single world-lines give rise to an atomic constant e, the charge on an electron, so the restrictions associated with pairs of world-lines give rise to a second atomic constant This is generally taken to be h, Planck's constant, but in many respects it is more appropriate to regard the product hC as the second constant, where C is the velocity of light It is significant that hC is of the same physical dimensions as e^2 and so may be regarded as being the same thing as e^2 except for a numerical multiplier. Thus while the restrictions connected with one world-line introduce e, those connected with two world-lines, depending only on e^2, introduce no essentially new constant, whence it may reasonably be suspected that the two sets of restrictions are merely different aspects of one and the same set It looks as though the atomicity of the quantum theory is only another aspect of the atomicity of electric charges

Quantum Restrictions

We can perhaps best visualise the inner nature of the quantum-restrictions by going back to the analogy of the two ships making a combined wash which is in some way restricted to being of a certain height We have supposed each wash individually to be restricted, if the velocity of the ships is fixed, this requires that each ship shall be of a definite size (corresponding to each electron having a definite charge) How can we now put a further restriction on the total wash of the two ships at points where their washes overlap? Only, I think, by keeping the ships at a specified distance apart At any rate this is the way in which the quantum-restrictions work. The normal hydrogen atom consists of a negative electron describing a circular orbit about a positively charged nucleus, the quantum-restrictions compel this orbit to keep an unvarying radius of $0{\cdot}53 \times 10^{-8}$ cm. When the atom is in an abnormal state, as, for example, when excited in a vacuum tube, the orbit, if circular, may have radii equal to 4, 9, 16, 25 . . times the radius of the normal atom. Elliptic orbits also are possible, but only of quite definitely restricted major and minor axes In actual fact the semi-major axis must be equal to one of the radii permissible for a circular orbit, while the ratio of the two axes must be one of a range of commensurable ratios. The orbits which are possible for the electron of the hydrogen atom are shown in Fig 2 If it were not for the quantum restrictions, it would be impossible to exhibit these orbits in a diagram at all; orbits of every radius and of every eccentricity would be possible, just as they are for a planet or comet describing an orbit about the sun.

It will be understood that I have not approached the quantum theory by the road of its historical development Planck originally discovered the existence of the quantum-constant h from a study of black-body radiation The famous theorem of equipartition of energy showed that if the classical laws of dynamics were of universal validity, the whole energy of the material universe would at once degrade itself into radiant energy of infinitesimal wave-length. Planck showed that this conclusion could be avoided by supposing that the energy of radiating mechanisms changed only by complete quanta, the change of energy $W_2 - W_1$

being connected with the frequency ν of the radiator by the relation

$$W_2 - W_1 = h\nu$$

He further showed that this supposition led to a law of spectral distribution of black-body radiation, the now famous Planck's law, which was found to agree excellently with the observed distribution. In this way the quantum theory came into being at the very beginning of the quarter-century we have under review.

Some years elapsed before Einstein showed that the same constant was of fundamental importance in the photo-electric effect, and it then began to be suspected that it might conceivably be fundamental to the whole of physics. But it was not until 1913 that Bohr published the epoch-making paper which first suggested, and at the same time finally established, that this constant held the clue to the structure of the atom and determined the scale on which the universe is built.

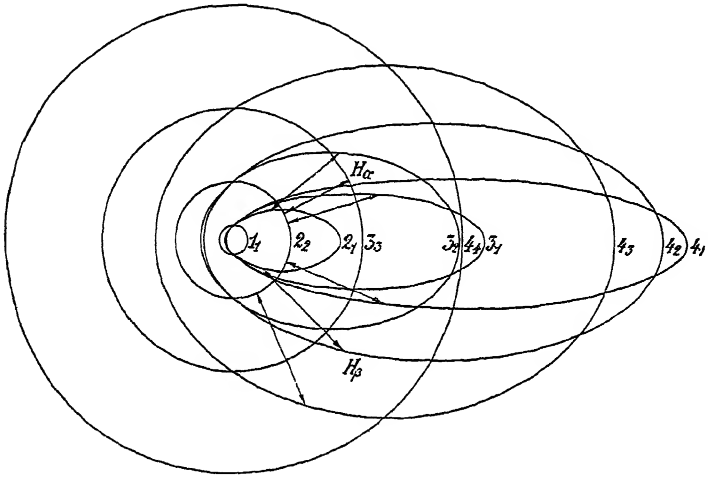

Fig. 2

To-night I have disregarded historical development altogether, and have tried to approach the theory in the simplest manner; I am trying to make it look natural. There can be no reasonable doubt that the quantum theory is essentially true, and so would appear perfectly natural to us if we could approach it with entirely fresh minds not already obsessed by erroneous ideas. But with our minds such as they are, the quantum theory as frequently presented does, it must be admitted, raise recollections of plausible conjuring performances. If I were to state the argument by which Planck first arrived at the existence of the quantum, the inclination might well be to dismiss it as mere mathematical sleight-of-hand. I agree it is still a bit surprising that the rabbit came out of the hat, but I have tried to show at least that there was so much room in the hat that almost anything might have emerged.

According to the Maxwellian electrodynamics an electron describing an orbit of any kind must necessarily radiate energy. We can calculate the rate at which energy ought to be radiated by the electron in the normal hydrogen atom; it is 0.46 erg a second. The resulting loss of energy would be compensated by a decrease in the radius of the orbit; we find that the rate of this decrease would be about 112 cm. a second, so that the atom ought to disappear altogether within a small fraction of a millionth of a second. Thus it is the quantum-restrictions which give a permanent existence to matter.

In conformity with the quantum-restrictions, the electron in the hydrogen atom describes an orbit of unvarying radius and so of constant energy. Maxwell's equations, as we have seen, would demand that radiation should be emitted and that the energy of the orbit should decrease accordingly. Here, then, we have a case where the requirements of Maxwell's theory and those of the quantum theory are in irreconcilable conflict. It is the quantum theory which carries the day. Somewhere before we reach the most minute of all structures, Maxwell's theory fails and the quantum theory takes its place. For large scale phenomena the two theories coincide—a thunderstorm is the same thing for Maxwell's theory as for the quantum theory, just as it was the same thing for the old "one-fluid" theory as for the modern electron theory—atomicity is of no consequence when the number of atoms involved approximates to infinity.

In terms of space curvatures we may say that Maxwell's theory is represented by a continuous curvature or crumpling such as might be applied to a rubber membrane, while possibly the quantum theory may be represented by a so-to-speak "jerky" deformation which is the best that can be done with a scaly surface such as a crocodile skin. If we wish to cover the earth's surface with a membrane, it makes little difference, from the point of view of closeness of fit, whether we select rubber membrane or crocodile skin, but it makes all the difference if we are manufacturing a pair of gloves. The quantum theory represents, perhaps, a quality of space, or rather of the four-dimensional continuum, which is somehow analogous to scaliness in a skin.

As the normal hydrogen atom is already in its configuration of minimum energy it can emit no radiation. But under electric bombardment or in the presence of intense radiation, the electron may move to other orbits of energy higher than the minimum. Even now there can be no gradual change of energy, but there can

be spasmodic jumps from one orbit to another orbit of lower energy. According to Bohr's theory of atomic mechanism, the energy lost to the orbit at each one of these jumps is emitted in the form of monochromatic radiation. A jump from energy W_2 to energy W_1 results in the emission of radiation of uniform frequency ν where

$$W_2 - W_1 = h\nu,$$

h being the absolute constant of Nature already referred to. If λ is the wave-length of the radiation, $\lambda = C/\nu$, so that

$$W_2 - W_1 = \frac{hC}{\lambda}$$

We have already seen that hC is equal to Ke^2 where K is a numerical constant. The energy in an orbit of radius r (or, if elliptical, of semi-major-axis r) is $-\frac{1}{2}e^2/r$, so that if the jump is from an orbit of radius r_1 to one of radius r_2,

$$\tfrac{1}{2}e^2\left(\frac{1}{r_2} - \frac{1}{r_1}\right) = \frac{Ke^2}{\lambda},$$

and the wave-length of the radiation is given by

$$\frac{2K}{\lambda} = \frac{1}{r_2} - \frac{1}{r_1}.$$

Now if a is the radius of the normal hydrogen atom, the possible values for r_2 and r_1 are 1^2, 2^2, 3^2, 4^2 . . times a, so that our formula becomes

$$\frac{2Ka}{\lambda} = \frac{1}{n_2^2} - \frac{1}{n_1^2}.$$

In actual fact a formula of this type, in which n_1 and n_2 are given all possible integral values, is found to give with the utmost exactness the wave-lengths of the light emitted in the complicated spectrum of the hydrogen atom. On putting $n_2 = 2$ we obtain the Balmer series of lines, of which the principal lines H_α, H_β, H_γ . . . form the most conspicuous feature in the ordinary hydrogen spectrum. The lines obtained by putting $n_2 = 1, 3, 4, 5$ are mostly in the infra-red or the ultra-violet. Many of these have been observed, and there is no reason to doubt that the remainder are there, although at present beyond the range of observation.

So far we have considered only the circular orbits; there must, of course, be other spectral lines arising out of the possibility of the electron describing elliptic orbits. Exact analysis shows, however, that these latter lines coincide almost exactly with those already discussed. They would coincide perfectly if it were not that the mass of a moving electron depends on the velocity of its motion. As a consequence of this dependence of mass on velocity, the two sets of lines do not exactly coincide. Each line of the simple series previously discussed is replaced by a "fine-structure"—a bunch of lines quite distinct in fact, although so close together as to look like a single line in all save the most powerful spectroscopes. Sommerfeld has worked out the structure to be expected theoretically for these bundles of lines and obtains a most gratifying agreement with observation. This and other experimental tests give the most convincing proof of the accuracy of Bohr's theories of atomic mechanism.

We can gain a knowledge of the arrangements of the electron orbits in even the most complicated atoms by using the equation

$$W_2 - W_1 = h\nu,$$

which appears to be of universal validity. The frequencies ν of radiation can be measured, so that the energy-levels W_1, W_2 . . of the various possible orbits can be calculated. The method has been applied not only to discovering the arrangements of electrons in the atom, but also to discovering the energy-levels of the protons in the nucleus. At present the hydrogen atom and the positively-charged helium atom are the only structures which are completely understood, but there can be little doubt that in time the method will unravel for us the secrets of even the most complicated of atomic and molecular structures.

Already Bohr has constructed a table, of which the first part is shown in Table I, in which he attempts to assign the different electrons in the atoms to the

TABLE I.—ELECTRON ORBITS

	1_1	$2_1 2_2$	$3_1 3_2 3_3$	$4_1 4_2 4_3 4_4$	$5_1 5_2 5_3 5_4 5_5$
1 H	1				
2 He	2				
3 Li	2	1			
4 Be	2	2			
5 B	2	2 (1)			
— —	—	— —			
10 Ne	2	4 4			
11 Na	2	4 4	1		
12 Mg	2	4 4	2		
13 Al	2	4 4	2 1		
— —	—	— —	— —		
18 A	2	4 4	4 4		
19 K	2	4 4	4 4	1	
20 Ca	2	4 4	4 4	2	
21 Sc	2	4 4	4 4 1	(2)	
22 Ti	2	4 4	4 4 2	(2)	
— —	—	— —	— — —	—	
29 Cu	2	4 4	6 6 6	1	
30 Zn	2	4 4	6 6 6	2	
31 Ga	2	4 4	6 6 6	2 1	
— —	—	— —	— — —	— —	
36 Kr	2	4 4	6 6 6	4 4	
37 Rb	2	4 4	6 6 6	4 4	1
38 Sr	2	4 4	6 6 6	4 4	2
39 Y	2	4 4	6 6 6	4 4 1	(2)
40 Zr	2	4 4	6 6 6	4 4 2	(2)
— —	—	— —	— — —	— — —	—
47 Ag	2	4 4	6 6 6	6 6 6	1
48 Cd	2	4 4	6 6 6	6 6 6	2
49 In	2	4 4	6 6 6	6 6 6	2 1
— —	—	— —	— — —	— — —	— —
54 X	2	4 4	6 6 6	6 6 6	4 4

various orbits permitted to them by the quantum theory The numbers in the top line specify the orbits in terms of their principal and subsidiary quantum numbers. The numbers below are the numbers of electrons which follow one another round in these different orbits. It will be noticed that in the simpler elements there are never more than four electrons in the same orbit, although in the heavier elements six and afterwards eight electrons may inhabit the same orbit. The table is largely conjectural, but recent spectroscopic research has gone far towards establishing its essential accuracy. When we remember that it is less than twelve years since Bohr first suggested that the quantum theory might provide the clue to the structure of matter, we must agree that the progress of the theory in these years has been remarkable

The Nature of Radiation

The quantum theory has been less successful in discovering the nature of radiation, although even here it has been beyond comparison more successful than any previous theory To illustrate the difficulties of the problem, let us consider one single phenomenon—the X-ray photo-electric effect A thin stream of electrons each moving with the same high velocity is allowed to impinge on a material target, and X-rays are emitted which carry off the energy destroyed by the collision These X-rays pass through a gas, and it is found that as soon as the process starts, atoms are ionised and shoot off electrons with a velocity equal to that of the original stream of electrons Even if the density of X-radiation is so slight that, according to the old view of radiation, an atom would take years to absorb the energy necessary for ionisation, nevertheless ionisation is found to begin at once, energy being absorbed which is not only sufficient for mere ionisation, but also suffices in addition to endow the ejected electron with high velocity.

Such a phenomenon is of course totally inexplicable in terms of the luminiferous ether, or even in terms of Maxwell's equations. The quantum theory gives only a partial explanation Since the frequency ν of the X-rays does not change with their passage through space, the equation $W_2 - W_1 = h\nu$ shows that the change of energy at the one end of the chain must be equal to that at the other. Thus as much energy is necessarily yielded up to one electron as is destroyed in another, but this does not touch the problem of the mechanism by which this energy is transferred.

Einstein at one time suggested that radiant energy was hurled through space tied up in indivisible packets like bullets from a rifle, but it has proved quite impossible to reconcile this suggestion with the optical phenomena of interference. A more recent hypothesis, also due to Einstein, calls for a revision of our conception of the action of an electric field on an electron

According to the usual electrical theory, an electric force X acting on an electron of charge e and mass m for a time t produces a change of velocity equal to

$$\frac{Xet}{m}$$

According to Einstein's recent theory of radiation, this is only true if X arises from a steady field or from a field which changes infinitely slowly. A force X which results from the incidence of radiation will in general produce no change of velocity at all in an electron Indeed a bound electron is compelled to describe a fixed orbit with a prescribed velocity which cannot change, while a quite simple argument shows that it would be contrary to the fundamental equation of the quantum theory for a free electron to have its velocity changed by radiation Einstein, following Bohr, supposes that under certain conditions a bound electron can have its velocity changed by a definite amount Q. This amount is not equal to Xet/m, but is determined by the position and motion of the electron in the atom to which it belongs; Q must be such as to move the electron into a new orbit which is also one of the permitted few The chance of such a jump of velocity occurring is supposed to be

$$\frac{(Xet/m)}{Q}$$

This conception immediately explains the otherwise incomprehensible photo-electric effect as well as other puzzles in the behaviour of radiation The difference between a strong and a weak electric field acting on an electron is no longer that the strong field produces a big change of velocity and the weak field a small one, it is that the strong field has a big chance of producing a change, and the weak field only a small chance of producing the same change When radiation acts on a body containing a great number of electrons, the final result is the same on the new theory as on the old. But there is a difference of method which is similar to the difference in propulsion between a motor-car and a steam-engine, on the new theory the charged body is propelled by a succession of little kicks, whereas on the old theory it was propelled by a steady pressure.

I have tried to sketch the outlines of the changes which the past quarter-century has introduced into our conception of the nature of electric forces and of the electromagnetic field You will agree with me that there have been giants at work in the field of pure electrical theory. When the history of present-day science comes to be finally written, the quarter-century we have just lived through will, so far as we can now judge, stand out as the period in which man first began to understand the true nature of electricity.

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Oceanic Research.

IN his presidential address to the British Association at the Cardiff meeting of 1920, the late Sir William Herdman suggested that the time had come for a new deep-sea expedition on the scale of the *Challenger* voyage of 1872–74 This proposal was discussed at various Association meetings , a tentative scheme was approved and was then submitted for the consideration of other scientific bodies The time, however, was regarded as inopportune and the proposal was not taken up Now, it appears, the movement may come from the United States

In 1923, Dr H C Hayes, of the U S Navy, developed a very ingenious method of taking almost continuous ocean soundings by means of a sound-wave transmitted to, and reflected back from, the sea bottom This "echo-sounding" presented such possibilities for oceanographic surveys that definite suggestions were made for a national expedition, and, after considering these, Col Theodore Roosevelt, the Acting Secretary of the U S Navy, summoned a meeting of representatives of government departments and extra-governmental establishments. This was held in July 1924, and was addressed by the Hon. Curtis D Wilbur, Secretary of the Navy A committee then prepared a report which was adopted by the conference and sent to the Secretary

The report recommends that a vessel, with officers and crew, should be supplied by the Navy. A scientific staff, consisting of an oceanographer, a biologist, and a geologist—all men of outstanding attainments—with six or more scientific assistants, will, it is expected, be provided from sources other than government funds. The cost of the first year's work, apart from the maintenance of the vessel and the salaries of the scientific staff, is estimated at about 57,000 dollars How long the expedition will be away is not considered, but it is contemplated that a naval vessel will be permanently employed on oceanographic research

The problems upon which the expedition is expected to concentrate are briefly outlined—they constitute a programme which is new, in some ways, and particularly attractive The work of the *Challenger* was very comprehensive, but, in the main, it was biological in its attitude Now, since 1872, the science of geophysics has been developed, and more attention is being directed to the morphology of the ocean floor. Existing oceanic soundings are so few that they are of little use in detailed studies, and so the method of finding the depth by echo-sounding must be largely used in any new oceanic expedition. During the last twenty years or so, a very extensive investigation into the subject of isostatic compensation in the earth's crust has been made by

the U S Coast and Geodetic Survey. The work accomplished has, however, been practically restricted to the North American continent, and its extension to the ocean floor and the deeps is most desirable.

Other geophysical problems demand close observations of the precise forms and positions of the deeps—the question, for example, of the downward warping of the ocean floor along the continental margins suggests the need for great numbers of new soundings in all regions Evidence of submarine upheavals and dislocations, and of the occurrence and frequency of submarine earthquakes and volcanic eruptions, is urgently needed. There is necessity for a renewed investigation of the deposits on the ocean floor. Determinations of mean ocean depth in chosen places are needed Oceanic tides have scarcely at all been investigated, and even ocean currents are not so well known as they ought to be. The forms, heights, and velocities of ocean waves also require study

Further, the great development of radio-telegraphy and telephony has suggested problems for which a much extended knowledge of electrostatic and electromagnetic fields in the atmosphere is required Since the ocean covers five-sevenths of the earth's surface, most of this kind of investigation must be undertaken at sea. The distribution of icebergs on the margins of steamship routes is already being studied by the U S. Government, but a great extension of the field of investigation is necessary Now, in addition to all these subjects of investigation, there are, of course, the routine physical and biological methods of research into the ocean water itself and the fauna of the sea floor. This would be done as a matter of course, but it is very interesting to see how "up-to-date" in its attitude to growing science is the programme for this new expedition.

It is recommended that the area of investigation should (at first) be the Gulf of Mexico and the Caribbean Sea. Then the research is intended to spread through the Panama Canal and to take in the North Pacific on one hand, and the North Atlantic on the other At the present time oceanographic investigation of the Pacific Ocean is by far the most attractive side of the subject There we obviously have ocean basins and continental margins *in the process of making* (for in the greater part of the Atlantic something like stability has been reached, and the problems there centre round sedimentation on the region of the continental shelf) A geophysical expedition dealing with the oceanic part of the earth's surface (for that is evidently what the present trend of scientific discovery suggests) cannot afford to concentrate on any relatively small part of the Pacific and Atlantic areas—the whole of the former region requires multitudes of ocean soundings at the very least. If, then, this big American expedition begins work very soon (and there is every likelihood that it will do so), the question of co-operation ought to be considered it is a pity that such action was not discussed, and proposals of some kind made, at the conference

At all events, the time is ripe for a consideration of the position of oceanographical investigation by Great Britain and other countries For a long period now the objects of deep-sea expeditions have been very much the same as those of the *Challenger*—that is, the study of abyssal and pelagic ocean life, with the investigation of the physical conditions that influence the distribution and density of faunas and floras. Since the beginning of the work of the International Council for the Exploration of the Sea, oceanic research has had a strong fisheries bias, and, at the present time, a great deal of such investigation is actually in progress in the north European region this is likely to develop still further its utilitarian and fishery objects, and its interest tends to become a very specialised and even an administrative one. We plead here for an interest which is much wider and should be purely scientific. During the last twenty years or so (and largely because of the original work of the International Council) oceanographic physico-chemical methods have been well developed Hydrodynamical methods, on the mathematical side, are remarkably well developed and are far ahead of the observational side of the science. This is also the case with theoretical geophysical research · it waits for a sound and very extensive basis of observations, and that cannot be given by any amount of geological work on the land, for research on the five-sevenths of earth surface that is occupied by the ocean is urgently required

Every consideration points, therefore, to deep-sea investigation on rather new lines, and the progress of geophysical and hydrodynamical research on one hand, and of oceanic meteorology on the other, suggest what these new directions ought to be Now that a lead has been given by the proposed American naval expedition, it would be very gratifying if a similar British naval one could be planned out, and if it could be arranged that a large measure of co-operation of aims and methods were secured. In spite of all that has been done in Great Britain on fishery investigation, it is nevertheless true that scientific oceanography has been neglected ever since the time of the *Challenger* expedition, and we cannot see any reason why a small fraction of the resources and interests of our Admiralty should not be directed to the prosecution of pure oceanic research without a necessary utilitarian object

Scientific Exploration in the Karakorum Mountains.

Paesi e Genti del Caracorum Vita di Carovana nel Tibet Occidentale By Giotto Dainelli (Pubblicato sotto gli auspici della R Società Geografica Italiana) Vol 1 Pp viii+291+74 plates Vol 2 Pp. iv+323+95 plates (Firenze Luigi Pampaloni, 1924) 120 lire

THE Karakorum Mountains are of special interest, as they contain the greatest glaciers known outside the polar regions and Mt Godwin-Austen, or K 2, the third highest summit of the Himalaya Scientific knowledge of the country has been collected by many distinguished explorers, including the brothers Schlagintweit in 1854–6, Godwin-Austen in 1860–1, Sir Francis Younghusband in 1887, and Sir Martin Conway, who in 1892 traversed the full length of the three longest glaciers and mapped them In 1913–14 the country was visited by an Italian expedition under Dr Filippo de Filippi, who had accompanied the Duke of Abruzzi on his expeditions to the same region and East Africa When de Filippi received the medal of the Royal Geographical Society for his share in these explorations, the two Asiatic expeditions with which he was concerned were described by Sir Francis Younghusband as the best led and scientifically equipped expeditions which had up to then worked in the Trans-Himalaya The full narrative of the expedition will be given in a promised monograph by de Filippi The present work consists of the journals of its geologist, Dr Giotto Dainelli, and it records his personal experiences and observations He is well known from his work in East Africa, reminiscences of which lead to his contrasts between the modest simplicity of African caravans and the large cavalcade and numerous companies of coolies of Asiatic expeditions. The work also expresses the fascination of this country as compared with tropical Africa, owing to the more advanced architecture, culture, and religious development

The two volumes tell the story of the journey from Marseilles to Bombay, and thence through Kashmir and by the well-known road across the Himalaya by the Zogi La to Dras and to the Indus at Tolti and Skardu Thence Dr Dainelli made a series of expeditions through the Karakorum valleys He reached the ends of the Baltoro and Biafo glaciers, which were surveyed by Sir Martin Conway The nearest comparable height among the glacial endings given is that of the Biafo, which Dainelli puts at 10,049 ft and Sir Martin Conway determined as 10,120 ft, so there had been no material movement of the end of that glacier in the intervening twenty years Dr Dainelli did no serious mountaineering in this district and Sir Martin Conway's maps of the glaciers are incorporated in the author's general map Later on, in the north-eastern Karakorums, Dr Dainelli explored some less-known regions, including the Rimu Glacier, one of the sources of the Yarkand River, and there the expedition added materially to geographical knowledge After many journeys in the valleys south of the main glacial region of the Central Karakorums, the expedition proceeded to Leh. Dr Dainelli shows the charm of that country by many photographs of the picturesquely placed monasteries or gompas, and his descriptions of the religious dances.

From Leh the expedition proceeded north-westward to Depsang, on part of the way using yak, which the author describes as the camel of the mountain deserts He visited some little-known valleys, and, among other features of interest, various hot springs and salt lakes In this district Dr Dainelli crossed the routes of the Schlagintweits, whose work he praises highly, though in parts of this country the latest Indian map was so sketchy that he could not determine his place on it. From Depsang he explored the Ciong Cumdan and Rimu Glaciers, with their interesting moraines, glacial lakes, and stratified ice Thence following the Yarkand River, the expedition descended, with obvious regret, from the mountains to the monotonous steppes of Turkistan. During the return journey the explorers were arrested at Moscow as German spies, but promptly released on the intervention of the Italian Ambassador; they proceeded through Petrograd and Stockholm to Berlin, which the author describes as in October 1914 apparently following its normal life.

The two volumes of Dr Dainelli's experiences give an interesting account of the conditions under which the work of the Filippi Expedition was conducted and show what great opportunities its members enjoyed The author describes the work as a faithful journal of his share in the expedition, and it gives useful observations on the topography and people Its value as a work of reference is much lessened by the absence of an index, which would be especially useful where the spellings in the text and map differ, as in Olang and Olting The expedition worked near an area of special interest in reference to the structure of Central Asia. The observations of this expedition may resolve the different interpretations of the Mustag-ata which, according to Suess, is a transverse meridional chain breaking unexpectedly across the main trend of the Asiatic ranges This conclusion was rejected by the late Sir H H Hayden, who did not, however, fully explain the facts of which Suess's view was offered as an interpretation. There is but little information on these questions in the journal, though the expedition obviously collected much new material. Dr Dainelli remarks, for example, that the Museum of San Marco

would not have space to hold their collections of fossils, but as to what the fossils are we must wait for the later monographs Similarly, the rocks are often graphically described, but they are not identified, and the picturesque pinnacles and masses of limestone shown in the photographs are of unstated age.

The technical work of the expedition is being published in 13 parts, dealing with the geology, geography, palæontology, petrology, ethnology, botany, zoology, and geodesy The only report yet issued is that on the glaciers, a volume with a fine atlas by Dr Dainelli His journal is illustrated by numerous beautiful photographs and a four-sheet topographic map on the scale of 1-750,000, which is a valuable addition to the geography of the central and north-eastern Karakorums.

J W. G

Studies in the History of Medicine

(1) *Essays on the History of Medicine* Presented to Karl Sudhoff on the occasion of his Seventieth Birthday, November 26, 1923, by Sir T Clifford Allbutt, Arturo Castiglioni, Friedrich Dannemann, Paul Diepgen, Erich Ebstein, Fielding H Garrison, Ernst Howald, Arnold C Klebs, E O von Lippmann, Max Neuburger, Sir Humphry Rolleston, Henry E Sigerist, Charles and Dorothea Singer, W G Spencer, Georg Sticker, E C Streeter, Lynn Thorndike, G A Wehrli, and Edward Theodore Withington Edited by Charles Singer and Henry E Sigerist. Pp v+418+24 plates (London Oxford University Press, Zurich: Verlag Seldwyla, 1924) 42*s* net.

(2) *The Doctor's Oath an Essay in the History of Medicine* By W H S Jones Pp. vi+62. (Cambridge: At the University Press, 1924) 7*s* 6*d* net.

(3) *A Pioneer of Public Health—William Thompson Sedgwick.* By E. O Jordan, G C Whipple, and C.-E. A Winslow Pp. xvi+193+5 plates. (New Haven: Yale University Press, London. Oxford University Press, 1924.) 18*s* 6*d*. net

(1) THE *Festschrift* dedicated to Prof Karl Sudhoff on the occasion of his seventieth birthday consists of eighteen essays contributed by writers from England, the United States, Germany, Austria, Switzerland, and Italy The essays, eight of which are in English, nine in German, and one in Italian, have been classified by the editors into the five groups of antiquity, Middle Ages, Renaissance, modern times, and general subjects respectively

The first group contains essays on prehistorical attempts to prevent and stamp out epidemic disease, by Dr Georg Sticker of Wurzburg, the work of Philolaus, by Dr Ernst Howald of Zurich, and the scientific treatises ascribed to Theophrastus, by Dr Lynn Thorndike of Cleveland In the section devoted to the Middle Ages, Dr E O von Lippmann of Halle writes on the history of alchemy, Dr Diepgen of Freiburg discusses the influence of the Middle Ages on the progress of medicine, Dr. and Mrs Singer deal with the origin of the medical school of Salerno, which they show to be the result of combined Greek, Latin, Jewish, and Saracen influences, Dr E T Withington gives an account of Roger Bacon's work entitled "On the Errors of Physicians", and Prof Arturo Castiglioni devotes an illustrated article to blood-letting in the arms of the Manfiedi, lords of Faenza The third section contains papers by Dr Henry E Sigerist of Zurich on the birth of Western medicine, fifteenth-century miniatures of extra-mural dissection by Dr E C. Streeter of Harvard and Dr Charles Singer; the "Practica of Gianmatteo Ferrari da Gradi, editio princeps," by Dr Arnold C. Klebs of Noyon, and the "Epitome" of Vesalius on vellum in the British Museum, by Mr W G Spencer

Modern times are represented by contributions from Sir Humphry Rolleston on the reception of Harvey's doctrine of the circulation of the blood in England as exhibited in the writings of two contemporaries, namely, Thomas Winston (1575–1655) and Henry Power (1623–1668); from Colonel Fielding Garrison, on the newer epidemiology, and from Dr. Erich Ebstein of Leipzig on Frank Joseph Gall The last group contains papers by Prof Max Neuburger of Vienna on the history of the problem of Nature healing, parallelism in the development of the natural sciences and therapeutics, by Dr F Dannemann of Bonn, and the essence of folk medicine and the necessity for its historical study, by Dr G A Wehrli of Zurich.

A bibliography of Prof. Sudhoff's works on the history of medicine, compiled by Dr Sigerist, is appended

No higher praise can be given to the volume than by saying that it is worthy of its recipient, whose services to the history of medicine are gracefully acknowledged in the preface by Sir Clifford Allbutt The work is well printed, and accompanied by numerous excellent illustrations

(2) Mr. W H S Jones's scholarly work on the Doctor's Oath will interest alike the historian of ethics and the medical practitioner, inasmuch as medical ethics and the medical etiquette of the present day are based upon this famous oath

After a brief account of the manuscripts of the Hippocratic collection, with an enumeration of the best manuscripts containing the oath, the Greek text of the Pagan Oath is given, with the English translation and critical footnotes The chief variants in the later manuscripts are noticed, and are followed by a full

transcription of the Milan manuscript Ambrosianus B 113, which contains both the pagan and the Christian oath The Greek text of the Christian modification of the oath, which in two manuscripts is written in the form of a cross, differs from the pagan oath in its omission of (1) reference to the pagan deities, (2) of all clauses in which preferential treatment is promised "to my teacher, his sons, my sons, and to those who have sworn allegiance to the physician's law," and (3) reference to a reward for instruction

The Arabic text is also reproduced, as well as two Latin translations ascribed to N Perotti and Nicholas of Regium respectively

In the subsequent commentary Mr Jones points out that though the first certain reference to the oath is in the preface to Scribonius Largus, who flourished in the reign of Claudius, there is a possible allusion to it in the *Thesmophoriazusæ* of Aristophanes, *i e* as early as 400 B C The two versions of the oath, pagan and Christian, and their variants, suggest that the document had a wide circulation The extant evidence does not conclusively prove that the oath was ever actually administered, and Mr Jones suggests that it was "a counsel of perfection expressed in the form of an oath, just as many sepulchral epigrams in the Greek anthology are literary efforts which have never appeared on tombs"

In an appendix Mr Jones compares the oath with the addresses to medical students in the old medical books of India, and reproduces the oaths still in use at the Faculties of Medicine at Montpellier and Glasgow

(3) The memoir on the late Prof. William Thompson Sedgwick, who has been called the "Father of Epidemiology in the United States," consists of a series of essays by his former pupils, Prof E O. Jordan, G C Whipple, and C-E. A Winslow, preceded by an introduction by Prof Sedgwick's widow In the first essay, which deals with the public health movement in the 'seventies, the writers, after acknowledging the indebtedness of the United States to British sanitary science, point out that public health in the 'seventies was almost wholly concerned with the problems of the non-living environment During Sedgwick's lifetime the public health movement assumed a biological character as the result of Pasteur's researches, and the way was laid open for the development of bacteriology and immunology

In the succeeding essay, which is entitled "The Gate of Knowledge," an account is given of Sedgwick's early life Though he registered as a medical student he never qualified as a medical practitioner, but devoted his whole career to biology, epidemiology, and public work. His most important achievement in the field of public health, of which an account is given in the following essays, was his investigation of a series of typhoid epidemics in 1894 which occurred in Massachusetts His next most important contribution to public health science was the development of laboratory methods for the study of the microbiology of air, water, ice, and milk He also paid much attention to the subject of food sanitation and conservation, and laid stress on the importance of statistics in epidemiology and of sanitary engineering, chemistry, and biology in the prevention of the chief communicable diseases

Finally, Sedgwick was well known as a lecturer in subjects relating to public health not only in the United States but also in Great Britain, where he acted in 1920 as an exchange professor in the Universities of Leeds and Cambridge The volume contains two appendices, consisting respectively of a bibliography of Sedgwick's writings and a list of his pupils.

Applied Elasticity.

Applied Elasticity By Dr John Prescott. Pp vii + 666 (London Longmans, Green and Co., 1924) 25*s* net

A STUDY of elasticity lying midway between that provided by Love in his "Theory of Elasticity" and by Morley in his "Theory of Structures and Properties of Materials" has long been required—a book, in fact, for the mathematical engineer. The present work, as its title indicates, is an attempt to fill that niche, and it contrives to do so with considerable success Incidentally it is an exposure of the narrowness of the field that has been explored mathematically with any certitude

The first three chapters deal with the analysis of stresses, the establishment of the equations, and a few particular solutions These are very clearly expounded. Then follows a chapter on the empirical basis of elasticity Considering the fundamental importance of this question and how necessary it is to realise the limitations involved in the basic assumptions and therefore imposed on the results of the theory in practice, it would be reasonable to expect a considerable chapter devoted to this question Out of nearly 670 pages, this chapter consists only of 4 pages The next seven chapters deal with rods under tension and thrust, in torsion, rods in longitudinal and torsional oscillation, and curved rods in equilibrium Following a chapter on spheres and cylinders come four on thin plates under various conditions of stress and one on rotating discs.

It is apparent at once that, roughly, the field amenable to mathematical analysis narrows itself down to a treatment of the simple geometrical forms—the line, the plane, the sphere, and the cylinder Even in these

regions it is not at all apparent how far the results obtained have actual validity When in design work, factors of safety—or ignorance—of 5, 6, and 7 are common, it cannot be expected that a piece of analysis, however beautiful or elaborate, will carry conviction unless point by point the deductions can be checked directly or indirectly by experiment The present work, we venture to think, would have been considerably enhanced by a larger proportion of space being devoted to experimental comparison, especially for a work on applied elasticity The limitations of the theory of Chapter vi., for example, dealing with the buckling of struts, to choose only one case, would have been apparent had some of the published results of such tests been introduced for comparison These would have enabled one to appreciate how far the simplifications involved in assuming idealised pin-joints, homogeneity of material, and lack of eccentricity generally are reflected in the calculations After all, it is vitally important to know how far applied elasticity can be relied upon for a prediction.

The author has apparently confined his attention deliberately to certain groups of questions There is no mention of the many applications of elasticity to aeronautics, to wing and fuselage structures, or to twisting and vibration of propeller blades. But we must not be over-critical He has undoubtedly produced an excellent and important contribution to the subject, not merely in the old matter which he has presented in new and refreshing form, but also in the many original investigations here published for the first time. We are grateful for it

Our Bookshelf.

Handbuch der allgemeinen Chemie. Herausgegeben von Prof Wilhelm Ostwald und Prof. Carl Drucker Band 4: *Das Leitvermogen der Losungen* Von Prof. Paul Walden Teil 1: Allgemeines, Grundlagen der Leitfahigkeitsmessungen, Methoden, Elektrolyte und Losungsmittel, Uberfuhrungszahlen, Ionenchemie Pp ix+383. 17 marks. Teil 2 und 3 Zahlenwerte des Leitvermogens in wasserigen und nichtwasserigen Losungen, Folgerungen, Gesetzmassigkeiten, Anomalien, Anwendungen. Pp. vi+346+v+397 47 marks. (Leipzig Akademische Verlagsgesellschaft m b H, 1924)

THE fourth "volume" of Ostwald's "Handbuch der allgemeinen Chemie" consists of three parts, under the general heading of "Conductivity of Solutions." The first of these parts deals with methods of measurements, and general questions, such as the hydration of ions, and concludes with a long section on transport-numbers and ionic mobilities The second part contains the numerical data in reference to conductivity in aqueous and non-aqueous solutions The third part deals with regularities and anomalies, as well as the application of conductivity-measurements to the study of physico-chemical problems

A quarter of a century ago, it was possible to deal fully with all these questions in a single small monograph Thus Kohlrausch's "Leitvermogen der Elektrolyte," published in 1898, contained only 227 pages, including the table of contents and tables of logarithms, etc. The three sections of Prof Walden's book cover 383, 347, and 397 pages respectively, apart from title-pages, etc, giving a total of well over 1000 pages Like so much other German literature of this kind, the book is amazingly complete. Every paper dealing with the subject appears to have been noticed, and even the most distant applications are discussed with full references to the relevant literature. Thus an organic chemist who is interested in free radicals or in carbonium salts will find the relevant data duly catalogued. It is impossible not to admire the patience and skill of the author in compiling so complete a work, and its value to workers and teachers cannot be exaggerated Its very completeness, however, makes it more suitable for use as a work of reference than as a text-book for students, unless as readers they possess the same amazing patience that the author has shown as a writer One of the principal uses of the book will, however, be as a mine of information for those who are responsible for teaching the subject, and in this way its publication may prove of real value even to the elementary student, but it would be an alarming prospect if so complete a volume should be taken by his examiners as indicating what the scope of his knowledge should be

The Military Uses of Astronomy. By Major F C. Molesworth Pp xii + 112 + 2 plates (London: Longmans, Green and Co, 1924) 3*s* 6*d* net

THE main impression created by reading Major Molesworth's handbook is that the task undertaken is rather a difficult one Its object is to explain the fundamental principles of astronomy, with practical application to the simple problems which present themselves to the soldier without requiring the use of instruments The knowledge demanded is modest enough, but to convey it in an accurate and attractive form is not easy With the necessary deductions for full-page diagrams and so forth, this book occupies less than eighty-five pages, and, partly from its brevity, the treatment of the subject appears rather unsatisfactory. The needful familiarity with actual problems can only be gained by assiduous practice, and it seems doubtful whether Major Molesworth's little work will provide the stimulus to bring out the necessary effort.

In spite of Sir W R. Birdwood's foreword, it seems but fair to recognise that the military uses of simple naked-eye astronomy are strictly limited It is inconceivable that any serious operation should be left to the chances of a fine sky. There is no apparent reason why, in normal circumstances, the watch and the compass should not be used for the purpose of determining time and direction In cases of emergency, as, for example, the escape of prisoners, readiness in making use of astronomical indications may be an invaluable resource, but only when more orthodox and trustworthy methods are not available

This is not to be understood as discouraging in any sense the study of the elements of astronomy, which can be recommended as a thing fascinating in itself and

specially valuable alike to soldiers and to all others who are liable to find themselves removed from the normal conditions of civilised life. But it has no value which is exclusively military, and a broader foundation is desirable than will be found in this book if the more valuable sequel of practical observation is to be expected

It should be mentioned that a special feature of the work is a set of diagrams giving for every 10° of latitude from 70° N to 40° S. the bearing and altitude of the sun throughout the year Something better in the way of star maps than the plates at the end of the book could easily have been provided.

A Manual for Spraying By K. L Cockerham Pp. xi + 87 (New York. The Macmillan Co, 1923) 7s net.

THIS little book on spraying is intended as a reference book and guide for practical men It is exceedingly brief, consisting of a short account of various types of spraying machines, including dusting apparatus; descriptions of and recipes for the more commonly used spray fluids, and a series of tables of insect and fungus pests, arranged under crop headings, giving the kind of injury caused by each pest and the spray recommended for its control. Unfortunately, the subject does not lend itself to quite such cut-and-dried treatment The identification of a pest from a description of the injury, which seldom exceeds five or six words in length, is rarely likely to be successful. Moreover, the instructions for making up the spray fluids are in some cases so brief as to be incomprehensible Chemical formulæ are used to excess, frequently without any clear indication of the ordinary name of the substance, and inaccuracies and misstatements are inexcusably numerous What is the fruit-grower to make of the following, with reference to Bordeaux mixture "The liquid should be thoroughly tested for excess of $CuSo_4$ and $Ca(OH)_2$ If it does not respond to these tests it is unfit for the purpose for which it is intended"? Under the heading of crude petroleum we get the information. "Specific gravity of crude petroleum ranges from 1 049 (A) (ethane) to 0 775 $^{18°}$ (hexadecane) Boiling-point of ethane as a solid is −86°." Sulphur dioxide has "specific gravity 1. 433680° 2. 2639(A)." Directions for the use of nicotine sulphate are included, but not for nicotine Many similar quotations could readily be given. If the author had left out most of the "chemistry" and devoted the space to some elaboration of the spray fluid recipes, the book might have proved useful to the growers and farmers for whom it was written As it is, it cannot be recommended as helpful. C. T. G.

Refraction of the Eye: including Elementary Physiological Optics By Dr. Charles Goulden. Pp. xii + 276 (London: J. and A. Churchill, 1925.) 10s. 6d net.

THE author tells us that this book is the outcome of a series of lectures which he has given at the Moorfields Eye Hospital to candidates for the new Ophthalmic Diploma of the Conjoint Board of England, and that its object is to give an exposition in as elementary a way as possible of the facts upon which the study of the refraction of the eye is based.

We may say at once that the book seems to meet these requirements in an admirable way. The headings to the seven chapters are. optics, the optical constants of the eye, the eye as an optical instrument; errors of refraction, the ophthalmoscope; retinoscopy; muscular anomalies In this type of book the student is apt to find that the optics and mathematics are not so elementary as the author supposes, he will find, however, in Dr. Goulden's book, that the mathematics required can quite safely be called elementary, and the descriptions are all so particularly lucid that he will find little difficulty in at once grasping the facts The diagrams, of which there are one hundred and eighty, call for special praise; they are bold and clear and the lettering could not be improved upon

It is a book that can be highly commended, not only to those whose immediate object is the negotiation of an examination test, but also to many who are well advanced along the road of ophthalmic practice and have not recently polished up such knowledge which is fundamental to the thorough understanding of much of their work There is a very full index, the type and general get-up are excellent, and we may confidently predict a long life in future editions.

Practical Forestry from a Workman's Point of View By A C. Drummie. Pp xii + 340. (London: G. Routledge and Sons, Ltd., 1924.) 7s. 6d. net.

THIS book is written "from a workman's point of view," and is in great measure the outpouring of one discontented with the present conditions of society in England, as such it may be left to the criticism of sociologists. As regards practical forestry, it contains nothing new or even freshly put, the matter being ill-arranged and mixed up with discussions on subjects the connexion of which with forestry is not obvious. The author, for example, "trusts readers will excuse a few remarks on the formation of coal," and proceeds to air his views "Why is coal put between species of stone or rock? Because the Almighty put it there, and no expert or scientist breathing will ever make the writer believe otherwise." This book is unsuitable for forestry students or woodmen who require accurate description and scientific method in their manuals of instruction It merits, however, the attention of both landowners and educationists, as its perusal shows how much remains to be done in the school and in the lecture hall to enlighten skilled workmen and artisans concerning the real aims of science.

Medical Hydrology: Outlines for Practitioners and Students. Based upon Lectures given at the University of London. By Dr R. Fortescue Fox. Pp. viii + 136 (London J. and A. Churchill, 1924) 6s net

THE application of various waters in the prevention and cure of disease is one of the oldest therapeutic measures known to medical science, and in the past has been mainly empirical In his outlines of medical hydrology, Dr. Fortescue Fox explains briefly the properties and actions of waters and discusses the rationale of treatment by their application His conclusions are summarised in a series of aphorisms, the dogmatic wording of which is justified in the preface The book will be useful to practitioners in exercising a choice of spas for the treatment of chronic disease.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

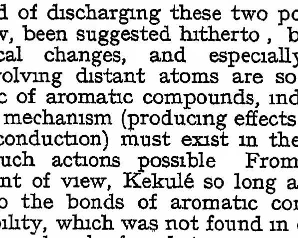
Graphitic Conduction in Conjugated Chains of Carbon Atoms: A Contribution to Armstrong's Theory of Chemical Change.

THE view put forward by Armstrong in 1885, that "chemical action is reversed electrolysis," has been brilliantly vindicated in the field of inorganic chemistry, especially by H. B. Baker's experimental verification of the bold prediction that highly purified water will not determine the explosion of hydrogen and oxygen. In organic chemistry similar evidence in favour of Armstrong's theory has been afforded by the proof that a catalyst is needed even to effect the transfer of an atom of hydrogen from one part of the molecule to another in prototropic compounds such as ethyl acetoacetate or nitrocamphor.

Whilst, however, it is easy to recognise that, in a chemical action between non-electrolytes, the catalyst may play the part of the *electrolyte* in a battery, and that the non-electrolytes themselves may act as *depolarisers* to the ions liberated by electrolysis, it has always been difficult to discover, in reactive systems from which metals in every form are absent, any analogue to the *metallic conductor*. Thus, we can picture the isomeric change of phenylchloroamine into parachloroaniline, $C_6H_5.NHCl \longrightarrow Cl.C_6H_4.NH_2$ (in which atoms of hydrogen and chlorine change places under the influence of hydrogen chloride), as depending on a process of electrolysis whereby the catalyst is resolved into hydrogen and chlorine, the *electrolytic hydrogen* being depolarised by the chlorine which it displaces from the side-chain, and the *electrolytic chlorine* by the hydrogen atom which it displaces from the para-position in the ring. This explanation, however, although complete from the chemical point of view, fails to explain the electrical action, since, in the absence of metallic conduction in the aromatic nucleus, it would leave a surplus of two electrons in the para-position and a deficit of two electrons in the side-chain, thus:

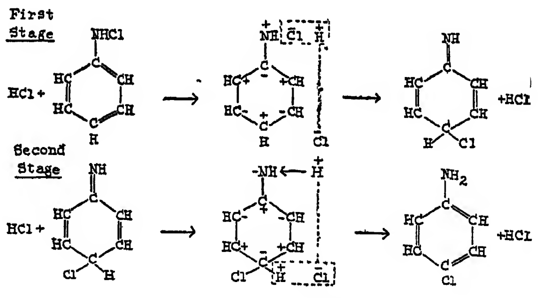
$$C_6H_5.NHCl \longrightarrow \overset{--}{Cl}.C_6H_4.\overset{++}{NH_2}$$

No method of discharging these two poles has, so far as I know, been suggested hitherto; but the fact that chemical changes, and especially isomeric changes, involving distant atoms are so peculiarly characteristic of aromatic compounds, indicates that some special mechanism (producing effects equivalent to metallic conduction) must exist in these systems to render such actions possible. From a purely chemical point of view, Kekulé so long ago as 1872 attributed to the bonds of aromatic compounds a peculiar mobility, which was not found in compounds of other types, when he found it necessary to explain the identity of the 1:2 and 1:6 derivatives of benzene by a spontaneous interchange of single and double bonds, as in the following scheme:



This interchange of bonds was not regarded, however, as conferring any special electrical properties on the molecules in which it took place. A similar mechanism was used by Lapworth in 1898 to explain the facility with which hydrogen and other radicals can wander between alternate atoms in unsaturated and conjugated compounds. This was attributed to the fact that, at each stage in the migration, the valencies can be adjusted by an interchange of bonds as in the scheme suggested by Kekulé. Thus when the hydrogen and chlorine in phenylchloroamine change places, the *chlorine* was supposed to wander first from the side-chain to the ring, with a simultaneous interchange of the alternate single and double bonds in the intermediate chain of atoms. The original arrangement is, however, restored by a second interchange of single and double bonds, when the *hydrogen* wanders in the reverse direction from the ring to the side-chain.

Lapworth suggested further that the radicals probably migrate *in the form of ions*, but did not put forward any mechanism for the transference of the electric charges left behind by these ions on the aromatic nucleus. If, however, we now add to the electrolytic theory of isomeric change as set out above, the view (based upon the electronic theory of valency) that *at each stage of the action the intermediate double bonds of the conjugated system are ionised*, in the manner suggested in my paper on "The Polarity of Double Bonds" (Jour. Chem. Soc., 1923, 123, 822-831), it will be found that the oscillation of double and single bonds, in the manner postulated by Kekulé and by Lapworth, has supplied the one feature that was needed in order to bring this interpretation into complete harmony with Armstrong's dictum, since the oscillation of bonds makes it possible for electric charges to be handed from one end to the other of a conjugated system, without any simultaneous migration of the intermediate atoms, *i.e. by a process which is analogous to metallic and not to electrolytic conduction*. The isomeric change of phenylchloroamine can therefore be represented as follows:



The chain of molecules of the catalyst through which electrolysis proceeds is here represented by two lines, thus, $\overset{+}{H}$ $\overset{-}{Cl}$, and, following Lapworth, the transference of the halogen is represented as preceding the transference of hydrogen; but the ionisation of the intermediate system of conjugated double bonds, first in one sense and then in the other, now prevents the accumulation of electric charges at the two poles. It is, therefore, at last possible to formulate a scheme which is just as satisfactory from the electrical as from the chemical point of view, since it reproduces in almost every detail the mechanism of an electric battery, with the possible exception of the precise way in which metallic conduction is effected.

The polarities of the carbon atoms of the ring, as shown in the first stage, are the opposite to those normally developed in derivatives of aniline; and a similar reversal is seen in the polarity of the chlorine, which is usually split off in presence of water as a *positive* ion, *e.g.* in combination with negative hydroxyl

as hypochlorous acid, or (if hydrogen chloride is present as well as water) in combination with a negative chlorine ion as gaseous chlorine It is, therefore, suggested that the polarities shown above are induced by a cathodic reduction of the chlorine of the chloroamine, accompanied by a simultaneous anodic chlorination of the *para* CH group, and that these conditions are sufficient to produce a reversal of the normal polarities of the system

In this connexion it is of interest to recall the fact that X-ray analysis has shown that the transparent non-conducting crystals of *diamond* are made up of quadrivalent atoms of carbon linked together tetrahedrally, just like the atoms of a saturated organic compound of the aliphatic series, but in the case of *graphite* it has confirmed the view, already established by chemical methods, that the conducting crystals of this form of carbon are built up from a network of hexagonal rings, of the same type as the conjugated systems of aromatic compounds, in which the carbon-atoms are virtually tervalent The suggestion that conjugated chains of carbon atoms, united by alternate single and double bonds, can perform the function of a metallic conductor is therefore in harmony with physical as well as with chemical observations Since, however, the temperature coefficient of conductivity of graphite is positive, whilst that of metals is negative, and since, moreover, we can now assert that the structure of the crystals and probably the mechanism of conduction is quite different in the two cases, it would be wiser to describe the transference of electricity through conjugated chains of carbon atoms as *graphite conduction*, rather than as metallic conduction, and this term has therefore been used at the head of this letter T M LOWRY

54 Bateman Street, Cambridge.

Influence of Radiation on Ionisation Equilibrium.

IN considering ionisation equilibrium of the type $M \rightleftarrows M^+ + e - U$, the usual method adopted is to write down the entropies of M, M^+, and e from the quantum theory, and then the law of reaction isochore is obtained from the equation $S + S' - s = -U/T$ In this way we obtain the law of ionisation equilibrium

$$\log \frac{x^2}{1 - x^2} P = -\frac{U}{2 \cdot 3RT} + \frac{5}{2} \log T - 6 \cdot 5. \quad (1)$$

The system is regarded as unary (one-component), *i e* all the reacting electrons as well as M are derived from the ionisation of M, but when there is excess of electrons, the system is binary and the equilibrium is expressed by the form first given by H N Russell, namely,

$$\log \frac{x}{1 - x} \cdot \frac{x'}{1 + x'} P = -\frac{U}{2 \cdot 3RT} + \frac{5}{2} \log T - 6 \cdot 5 \quad (2)$$

The process is regarded as an abrupt one, M-atoms passing directly under the influence of heat to the M^+-stage, without going through the intervening metastable states Darwin and Fowler have attempted to include these intervening states by adding to the right-hand side of equation (1) a function $B(T)$ Prof Russell has pointed out that neither equation (1) nor (2) can be regarded as final, because it fails to take account of the possible influence of radiation and excitation of higher states We may introduce the matter in the following way Suppose we have a mass of sodium-vapour in the solar chromosphere Then the ionisation of sodium atoms is determined not only by the temperature of the chromosphere (say 5000° C), but also by the intensity of photospheric radiation of wave-length λ less than the wave-length of the limit of the P series, passing through these sodium atoms This radiation has a higher temperature than the local temperature, hence, as was first pointed out by Milne, we have no thermodynamic equilibrium in the solar chromosphere The excited states are produced under the joint influence of temperature of the chromosphere and of the photospheric radiation passing through the chromosphere To the same class belongs the absorption experiments of Wood and others, in which a column of sodium or other vapour is acted on by light of much greater intensity than what would be produced at the temperature of the absorbing gas Here all the excited atoms, or ionised atoms, are produced by light only, and almost none are due to temperature

The general problem has been thus attacked In all photochemical reactions the equilibrium is determined by the intensity of light, and in treating these cases from the point of view of the phase rule, Smits expressed the opinion, without however giving his reason, that the ordinary Gibbs formula, $F = C + 2 - P$, must be replaced by $F = C + 3 - P$. We, however, arrive at the same result by assuming that the number of components has increased by one, the photochemically active light being regarded as a new and independent component In other words, when a normal sodium-atom passes to the $2p$-stage by absorbing the $h\nu$-pulse of D-radiation, then either the excited atom of sodium or the pulse of light may be regarded as a new component, except when the D-light is derived from the effect of temperature prevailing in the gas In the latter case, the system is a system of one component, as in the corresponding case of free electrons in equation (1)

We thus regard excited sodium-atoms as a compound, in a special sense, of normal sodium-atoms and D-pulse. It has been possible to deduce the equilibrium conditions in such cases by combining the methods given by S N Bose (*Zs f Physik*, vol 27, p 384) and P Ehrenfest We give only the final results If ρ_ν be the density of radiation which is absorbed, and if n_1 and n_2 be the concentration of atoms in the normal and excited states,

$$\frac{n_2}{n_1} = \frac{g_2}{g_1} \cdot \frac{\rho_\nu}{8\pi(h\nu^3/c^3) + \rho_\nu} \quad . \quad . \quad (3)$$

When the light is derived from the temperature of the system we can put

$$\rho_\nu = 8\pi \frac{h\nu^3}{c^3} \frac{1}{e^{h\nu/kT} - 1},$$

and we have

$$\frac{n_2}{n_1} = \frac{g_2}{g_1} e^{-h\nu/kT}, \quad . \quad . \quad . \quad . \quad . \quad (3a)$$

as is usually obtained from direct application of Maxwell's law, and g_1, g_2 are the weights of the two states If ρ_ν is very large

$$\frac{n_2}{n_1} = \frac{g_2}{g_1}, \quad . \quad . \quad . \quad . \quad (3b)$$

as we can expect from the definition of g_1 and g_2.

In the case of ionisation, let ν be the frequency of ionising radiation (supposed monochromatic) Then the law of ionisation is given by

$$\log \frac{x^2}{1 - x^2} P = -\frac{(U - Nh\nu)}{2 \cdot 3RT} + \log\left(\frac{\rho_\nu}{8\pi(h\nu^3/c^3) + \rho_\nu}\right) + \frac{5}{2} \log T - 6 \cdot 5, \quad (4)$$

where $N = R/k$

If

$$\rho_\nu = \frac{8\pi h\nu^3}{c^3} \frac{1}{e^{h\nu/kT} - 1},$$

i e. radiation is due to the temperature of the system, (4) reduces to

$$\log \frac{x^2}{1 - x^2} P = -\frac{U}{2\ 3RT} + \frac{5}{2} \log T - 6\ 5, \qquad (4a)$$

as is obtained directly from thermodynamical theories

Equation (4) expresses equilibrium in a two-component system, equation (4*a*) in a one-component system

Of course the ionising power is not limited to one single radiation, nor are all pulses of frequency $\nu > \nu_0$ (ν_0 = convergence frequency of the principal series) equally effective in causing ionisation But these facts can be taken into consideration in the method used above.

MEGHNAD SAHA
RAMANI KANTA SWE

Allahabad, India,
January 21

The Future of the Meteorological Office.

DR G C SIMPSON writes (NATURE, February 14) that he is sure I should not wish my remarks on the future of the Meteorological Office to be taken as more than my own personal opinion, but on the contrary I believe that my views are shared by a large number of meteorologists In 1920 the Royal Meteorological Society adopted a resolution regretting that the Meteorological Office had been placed under a Government department, created for another purpose, and urging that the Meteorological Committee should again have control, it was also pointed out that, when in the past changes had been made in the status of the Office, inquiries had been held On this occasion, since no report has been issued, we must conclude that the transfer of the Meteorological Office to the Air Ministry took place with no public inquiry, and to an outsider it appeared to have been made in a hurried and even arbitrary manner

The fear that the Meteorological Office may become a mere forecasting department of the Air Ministry, which is what I meant when I said that the future is uncertain, is not dispelled by Dr Simpson's reference to the "complicated meteorological service for aviation with its thirteen stations on aerodromes" The cares of hourly reports for aviators are not conducive to the development of scientific ideas, and a Government department which has such claims on the Meteorological Office may, under pressure for economy, neglect those aspects of meteorology not directly connected with immediate requirements. The pressure for economy may very likely prove stronger than an advisory committee It is with misgiving that one notices the giving up of the radio research station at Smallshot Hill (now fortunately taken over by the Radio Research Board), and the transfer of upper air research from Benson, originally chosen for its suitability for *ballons-sondes*, to Kew, where it is in charge of an assistant-superintendent in place of a director of experiments These researches, of great promise for the study of the atmosphere, were at the time of the change of no immediate utility to the Flying Service. When one considers the real additions to our knowledge of the atmosphere that have come from the freedom and seclusion of Pyrton Hill and Benson, it is almost painful to contemplate the rigorous conditions of a ministry as a nursery of research Such changes inspire the fear that other researches not directly connected with flying may be dealt with in like manner

If the Meteorological Office is to be only a forecasting office the chief work of which is for the Flying Service, I agree that it could not be in a better position than at present, but if it is still to be an instrument for the advance of the more purely scientific aspects of meteorology I am forced, despite the larger financial grant, to agree with the resolution of the Royal Meteorological Society I regret that I am constrained to disagree with Dr Simpson in this matter, the more so as I am indebted to him for continued help in many meteorological matters ever since he became Director I sincerely hope that he will be right and that I shall be wrong, but that the future only can decide In the matter of the present staff of the Meteorological Office I am in absolute agreement with Dr Simpson, and I used the following words in my address "The staff of the Office is composed of men of the highest scientific calibre, probably never before in its history has it contained such a galaxy of talent"

C J P CAVE.

Stoner Hill, Petersfield,
February 21

The Michelson-Morley Experiment.

IN their scheme of their experiment, Michelson and Morley selected a single incident ray, showed how this would divide into a transmitted and a reflected moiety, traced out the path-lengths and found the difference δ Then, comparing the results in two orientations, they computed the difference $\delta_2 - \delta_1$, which they estimated at $l \times 2\beta^2 = (0{\cdot}00000002)l$ when $\beta = v/c = 10^{-4}$ and the semi-translucent mirror is set at $\theta = 45°$ They applied this computed difference of path-differences to predict a shift of bands in an interference-field, but they did not go into the question how the interference-field (which is undoubtedly observed) is produced

The only way in which the scheme would work is to assume that the two virtual images of a point on the incident wave-front, formed by the two moieties from the single incident ray, themselves act as two virtual point-sources, capable of producing an interference-field Also, there must be some definite observation point within the interference-field

It does not seem to me to be reasonable to assume that the virtual images would act as luminous point-sources, because there would only be one ray to each virtual image, derived from the single incident ray

I have worked out the precise positions of the final virtual images and the precise single reflected rays passing through these, all as definite functions of c, v and the constants of the apparatus including θ; and I have found a reasonable observation-point, to be reached by the observing eye in a time t

Then, waiving objections to it for the moment, I have followed up the above implied assumption and calculated out the values of $(\delta_2 - \delta_1)$ for various values of v and various settings θ of the semi-translucent mirror The results are remarkable and unexpected.

Let the apparatus be ideally constructed, true right angles, equal arms, etc Let the semi-translucent mirror be set at an exact 45°, and let v be the full $c \times 10^{-4}$ Then (*a*) in both orientations the virtual images, assumed radiant, would be too close together (less than $\frac{1}{2}\lambda$ for yellow light) to produce any interference-field at all, and (*b*) $\delta_2 - \delta_1 = (0\ 0000,0000,0003,0002)l$

Therefore, on the single-ray scheme, when $\theta = 45°$ and $v = c \times 10^{-4}$, there ought to be no observable effect, not even an interference-field With θ still at 45°, but $v > c \times 10^{-4}$, as v increases the virtual images are farther apart, and if they acted as virtual point-

sources, an interference-field would begin to be possible until, at a certain large value of v, the breadth of bands would correspond to that actually observed The immediate neighbourhood of $\theta = 45°$ is a region of extraordinary sensitiveness, in which $(\delta_2 - \delta_1)$ passes twice through a zero value Very minute changes in θ make very great changes in the value of $(\delta_2 - \delta_1)$

The numerical data do not lend themselves to any general statement as to the value of v, but they point towards an actual value of v much greater than $c \times 10^{-4}$, however this may be accounted for So far for the single-ray scheme, with the assumption required by it

I prefer to deal not with a single incident ray but with an incident plane wave-front, and to study the kind of interference-field necessarily formed where the two reflected moiety-wave-fronts cross one another Each virtual "image" of the previous working now appears as a point on a virtual plane wave-front, which is at right angles to the corresponding "single reflected ray" of the previous working The working out is straightforward and unforced, and it again leads to remarkable and unexpected results

Assuming θ to be an exact $45°$, and $l = 1100$ cm in an apparatus of ideal construction as above, then with yellow light ($\lambda = 0\cdot00005892$ cm) we have in the first orientation a band-breadth of 11784 cm if $v = c \times 10^{-4}$, 117 84 cm if $v = c \times 10^{-3}$, 1·1784 cm if $v = c \times 10^{-2}$, and 0 011784 cm if $v = c \times 10^{-1}$

Assuming v to be $c \times 10^{-4}$, we similarly have band-breadths 0 0059 cm if $\theta = 45° + 1024''$, 0 59 cm if $\theta = 45° + 10''\ 3$, 3928 cm if $\theta = 45° + 0''\ 001$, 11784 cm if $\theta = 45°$, ∞ if $\theta = 45° - 0''\ 0005$, 11784 cm if $\theta = 45° - 0''\ 001$, 59 22 cm if $\theta = 45° - 0''\ 103$, 0 59 cm if $\theta = 45° - 10''\ 3$, 0·0059 cm if $\theta = 45° - 1036''\ 43$

Working out and tabulating combinations of various θ's and v's and orientations we might hope, if we had an extraordinarily accurate knowledge of the lengths and angles involved, to be able to reach a conclusion as to the operative value of v from the band-breadths alone The comparative shift of bands as between two orientations is not helpful in this respect, it depends upon a remainder in decimal places only, where we do not know either l or λ to a sufficient number of working figures ALFRED DANIELL

P S—By the courtesy of the Editor I have seen Sir Oliver Lodge's comment on the above letter May I explain further that no bands would or ought to appear unless the instrument be in sufficiently rapid motion *when the semi-translucent mirror is set at an exact* $\theta = 45°$, if at any other angle, there will always be a certain amount of separation of the virtual images which may not be sufficient to produce an interference-field until aided by a sufficient velocity of movement (smaller than in the former case) producing a farther separation of the virtual images The breadth of bands is a function of θ and v

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THE Michelson-Morley experiment looked for a shift of well-known interference-bands, about the formation of which there was no doubt or controversy Ordinary wave theory explains the appearance of these bands with ease Dr Daniell, however, claims that no bands would or ought to appear unless the instrument was in motion, and that the width of the bands is itself an indication of the rapidity of motion, which is thereby proven to have a high value This view is so hopelessly unorthodox that it is difficult to regard it with equanimity Probably he is attending to one single precise ray—whatever that may be—and not to a small portion of a wave-front, with its inevitable slight obliquities OLIVER LODGE

The Theory of Hearing.

IN his letter in NATURE of February 14, p 228, Prof Scripture directs attention to the valuable work on the theory of hearing done at the New York research laboratories of the American Telephone and Telegraph Company He refers to the papers of Fletcher, and of Wegel and Lane The results obtained by these experimenters, in his opinion, completely confute the resonance theory, though he considers that "The simple facts of the accelerated toothed wheel and of portamento speech ought to have been enough to convince any one"

All minds do not function alike, and those propositions which appear self-evident to one are by no means so to another As an illustration of this truism one finds that Prof Scripture, though he avails himself readily of the experimental results in question, rejects at once as unworthy of serious consideration the interpretation of those results given by the experimenters themselves To him it appears self-evident that the results are wholly inconsistent with the resonance theory, though the experimenters state their conclusions in terms of that modification of the resonance theory to which they give the name, the "dynamic theory"

The cochlea as conceived by Wegel and Lane is a highly damped resonating organ giving more or less localised responses to simple tones conveyed to it The pitch of the tones heard is determined by the maximum points of the disturbances in the basilar membrane By the term "non-linear" response they imply (as seems to the writer) that the relation at various pitch levels between the intensity of the impulse and the loudness of the tone heard cannot be expressed graphically by a straight line From this they deduce the generation of combination tones and subjective harmonics in the cochlea Their theoretical deductions from the results of their experiments are perhaps vitiated by reason of their having left out of consideration the progressive graduation in tension of the basilar fibres by the spiral ligament. In any case there is nothing in them inconsistent with the resonance theory

Fletcher's results are indeed startling at first sight The elimination of the fundamental and the first four upper partials from a clarinet tone produced no alteration of the pitch of the tone, the fundamental still appearing as the characteristic pitch He explains this as being due to the difference tone generated by the remaining partials To Prof Scripture this explanation appears so surprising that he can only express his feelings by a note of exclamation To the writer the suggestion appears rational, and indeed inevitable Are we to understand that Prof Scripture does not believe in the existence of the subjective difference tone? Prof D C Miller has analysed the clarinet tone He states that it may have twenty or more partials, with the seventh to the tenth predominating This latter group of partials are even stronger than the fundamental, and it is they which are chiefly concerned with giving the characteristic quality to the tone of the instrument. The difference tone of each successive pair of partials would, of course, have the same pitch as the fundamental Even after the elimination of the five lowest partials, there would still remain fourteen pairs of generators to supply this difference tone Possibly not all the partials would have sufficient intensity to act as generators, but the four predominating partials probably would All these experimenters ascribe the generation of the difference tone to the cochlea, and not to the middle ear, as Helmholtz suggested The writer has advocated the same view elsewhere, though not on the same grounds.

Prof Scripture states that his deformation theory is capable of explaining these, and indeed all other phenomena of sound perception Against this claim the writer feels impelled to enter a protest So far as he is aware, Prof. Scripture has never formulated a theory of hearing He has stated six "theses" (NATURE, April 26, 1924, p 605), none of them new, and all of them highly disputable, on which he proposes to construct a theory Now to the writer a "thesis" means a proposition stated for the purpose of proof or attempted proof No such proof has been brought forward To traverse these theses seriatim would be to review the controversies of the last sixty years The writer is unable to recognise any material points of difference between the theory foreshadowed in the theses and the "pressure pattern" theories of Waller and Ewald, which he has discussed to the best of his ability elsewhere He has already stated his objections in NATURE (May 31, 1924, p 781) to some of the chief points of the theses, without eliciting any reply

On the question of the nature of vowel sounds Prof Scripture speaks as an authority, but one may be permitted to point out that he is not in agreement with other authorities Prof Miller states "The results of the work here described [on the analysis of vowel sounds] are in entire agreement with Helmholtz's theory, and are therefore out of harmony with Scripture's arguments"[1] Later, he speaks of the fundamental tone of the vowel being generated in the larynx[2] When authorities differ, no single one of them is in a position to impose his own views as absolute

In any case the simple piano experiments described by Helmholtz and Ellis, and referred to in my former letters (NATURE, May 31, p 781, and July 19, 1924, p 87), afford direct evidence that vowel sounds are capable of being analysed by resonators, and consequently weaken any indirect argument against the resonance theory which may be deduced from the supposed nature of vowel sounds

G WILKINSON

Sheffield

[1] "The Science of Musical Sounds," D C Miller, p 217
[2] *Ibid* p 242

Ecology of Moorland Plants.

IN an article upon this subject in NATURE of November 8, Prof Priestley discusses the apparently xerophilous nature of the ericoid shoot, and concludes that a plant such as Calluna is better classed as a "xeromorphic mesophyte," which is "able to lose water like a mesophyte because in its natural habitat plenty of water is practically always available" This conclusion is preceded by a brief reference to the recent work of Stocker and Montfort showing that the water of moorland soils is not necessarily toxic to moorland plants, and does not, as Schimper suggested, diminish their effective water absorption Prof Priestley accepts their inference from these experimental results and states that the "physiological dryness" of a peaty soil is a "myth," and that therefore "there is not much left of the case for the xerophytic character of Calluna and the ericoid shoot"

I should like to point out that such experiments as those quoted are far from proving the non-xerophilous nature of the ericoid shoot, though they doubtless throw light on the very intriguing question of the water relations of ericoid shoots and leaves It is true that structural features such as rolled leaves, thick cuticle, and protected stomata do not necessarily indicate xerophily, but the mere capacity for active transpiration during plentiful water absorption certainly does not prove the contrary

The character common to all xerophytes properly so called is that of resistance to *drought* by any means, water storage, reduction of surface, etc This has become increasingly clear from numerous observations and experiments of late years (cf Holtermann, 1907; Fitting, 1911, Macdougall, 1912, Kamerling, 1914, Delf, 1915, the Maximows, 1924) The drought may arise either from atmospheric or from edaphic conditions, and may vary from a brief daily stress, as in the mangroves described by Holtermann (1907), to a prolonged water shortage, as in some typical Cactaceæ, but in either case the xerophyte can endure to lose water (often as much as about half its water content) without harm, whereas in mesophytic plants under the same conditions the leaves are wilted beyond recovery

How far Calluna and other British Ericaceæ have this drought-resisting capacity has never, so far as I am aware, been tested, but the careful investigations of Thoday (1923) show beyond doubt that Passerina, a South African plant of similar "ericoid" habit and structure, possesses it in a marked degree The water content of leafy shoots of Passerina gathered in the dry season varied from 25 per cent to 45 per cent (averaging about 30 per cent) of the fresh weight, the water content of specimens taken in the rainy season being usually about 60 per cent The shoots can thus lose quite half their normal water content without injury

The case for the xerophily of the ericoid leaves of the British Ericaceæ, though unproven, is thus still highly probable, whatever be the absorptive capacity of the root system when *sufficient* water is available It is, however, scarcely necessary to point out that, when water is present in the soil, it is not *necessarily* "available" to the plant in the physiological sense of the word, apart from any question of toxicity. "Availability" is estimated as that fraction of the water content of the soil at saturation which can be withdrawn by a well-established rooted plant before wilting can be detected The wilting point depends upon the constitution of the plant as well as upon other factors It was shown by Crump in 1911 that when Calluna grows on acidic peat only four-fifths of the soil water is available That is, if we call the water content of the saturated soil, reckoned per unit of dry weight, 100, signs of wilting will occur in Calluna whenever the remaining soil water has become reduced to 20 In *Erica tetralix* growing in the same soil, the signs of wilting occur when as much as 30 per cent remains Such plants may thus have apparently "plenty" of water but actually a water deficit (especially if transpiration is active at the time), which is exactly what would be expected from their structure It is not known how this condition of incipient wilting in Calluna reacts on the transpiration rate, but measurements of the water content of the plant as it occurs in Nature would probably reveal a much wider variation than is tolerated by plants of a typical mesophytic habit

Further experimental work is obviously needed before any more definite conclusions are drawn as to the xerophily of the Ericaceæ Whether their peculiar structure arises as "a natural developmental consequence of the characteristic metabolism of a root system growing in a soil that lacks sufficient aeration," as Prof Priestley suggests, is an entirely different question which is independent of the possible significance of the final differentiation attained

E. M DELF.

Westfield College
(University of London)

APART from the fact that the conclusion that Calluna is a "xeromorphic mesophyte" should be attributed to Stocker, there is nothing in Dr Delf's remarks with which I find myself in disagreement, except with regard to their relevance to the point at issue

Certain features of the structure of moorland plants, inrolled leaves, sunk stomata, thick cuticle, etc, have been explained teleologically as designed to reduce transpiration Stocker and Montfort show experimentally that the plants transpire very freely in spite of these features Dr Delf does not help the teleological argument by pointing out that, even though they lose water freely, the plants may still thrive because of other xerophytic characteristics Nor are Crump's results relevant to the problem of moorland plants growing in regions of excessive rainfall The contemplation of these same "xerophytic" structural features in such swampy moorland regions had led to the suggestion that the water might not be "physiologically" available, but Montfort's experimental results show that plants absorb it freely

It interested me very much to learn, from the presidential address of Prof F E Weiss to the Ecological Society on January 10 last, that these same structural features provide a similar puzzle to the palæobotanist On one hand, it is argued from such leaf characters that the coal measure forests grew under xerophytic conditions, on the other, from root systems and other features, it is argued that they grew in vast swamps J H PRIESTLEY

The Need for a Universal Language.

NOBODY, not even Prof Kent or Mr Heron-Allen, really wants Latin as a universal language Latin is dead, its natural development has ceased and could not possibly meet the growing needs of international thought Every one recognises that the classical tongue, if it is to satisfy modern needs, must have its grammar simplified and its vocabulary, especially of abstract terms, enlarged But the features which are to be changed are those which give Latin its peculiar savour and the educational value that some would claim for it "Modernised Latin" is not Latin at all, it is a hybrid jargon as artificial as Volapuk or Esperanto, as devoid of literary tradition, as incapable of artistic expression, as subject to national and individual vagaries Of this last defect, of which he accuses Esperanto, Mr Allen gives a crushing example Few but English speakers would understand *statio* for railway-station, few but blundering schoolboys would use *quae* as a substantive for *quis*

The Latinists are crying for the moon They want as a medium for international communication a "natural" language with at least the possibility of literature The thing is impossible To fulfil its object the medium must mean the same thing to all men, however diverse their mentality or experience The allusiveness that makes literature possible is the fruit of a common life and history, it is the fruit of that nationalist sentiment which it is one of the main purposes of the language to remove Universal intelligibility and artistic expressiveness can never be combined in a single medium, for art is the trick of meaning rather more than you say I hope nobody will reply that, if a universal language must always be divorced from literature, we are better without it That was the fallacy of Ruskin and the cause of most of the sordidness of the Victorian age An art which seeks to limit utility is doomed, and if literature is set in opposition to scientifically impersonal expression, literature will wither

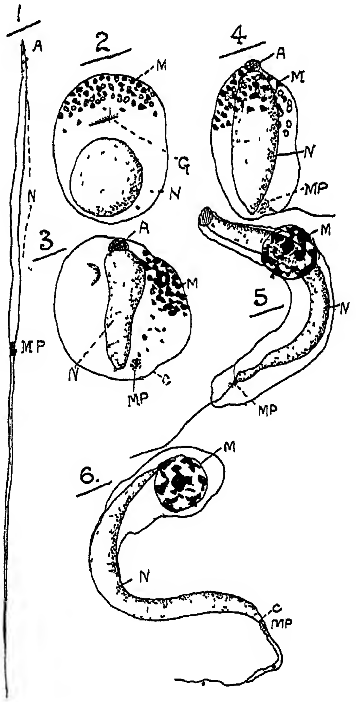
Of course, the view is tenable that modernised 'Latin," confessedly artificial and developed from the language of the Romans by some conventional scheme, would be better than its rivals even according to their standards But it is much more important to have some international language than to have the best conceivable Esperanto is within the bounds of practical possibility, it has made definite progress, it is supported by an enthusiastic organisation, it is actually being broadcast For the great mass of the unlearned, anything called Latin is eternally damned by its associations To some it suggests examinations and school punishments, to others pedantry and obscurantism It is not a practical possibility, and those who press its claims are merely hampering the cause they profess to serve

NORMAN R CAMPBELL.

Spermatogenesis of Peripatus

THIRTEEN years ago Montgomery, an American cytologist, published a paper in the *Biological Bulletin*, claiming that in Peripatus there was complete rejection of the mitochondria during spermateleosis This work has been widely quoted as strong evidence against the Meves' mitochondrial idioplasm theory, but Montgomery's investigation has never since been confirmed or denied

Owing to the good offices of Prof Gilchrist, of Cape Town, South Africa, and of Canon Forrester, Chaplain of Trinity College, Dublin, six small specimens of the Cape Peripatus arrived alive in Dublin, and I was able to procure some fairly good sections showing spermatogenesis



At first I believed that Montgomery was correct, but latterly I have modified my views In Fig 1, it will be seen that the middle-piece (MP) is very small — probably proportionately smaller than that of any other animal, consequently the problem of its manner of formation is not easy to solve Figs 2, 3, 4, and 5 show the mitochondria at M, finally forming a ball, as claimed by Montgomery This ball is certainly extruded (Fig 6) as explained by Montgomery, but if one examines a large number of well fixed cells at the stages depicted in Figs 3, 4, and 5, one will nearly always find a number of fine granules (MP) which eventually form the middle-piece of the tail I think that these granules are of the nature of mitochondria, because their reactions are similar, and I have got the impression that the middle-piece of the Peripatus sperm is formed from a few of the finer

mitochondria, whereas the main bulk of the coarse granules are rejected. In dealing with such a small cell, and when such small quantities of material are involved, it is not possible to be more explicit. It can be said with certainty that the middle-piece is formed from definite granules which do not appear to be secreted *per se* in the ground cytoplasm.

J. BRONTE GATENBY.

Trinity College, Dublin,
February 10.

Intermetallic Reactions in a Lead-base Bearing Metal.

AN investigation into the influence of pouring temperatures and mould temperatures on the microstructure of a lead-base bearing metal of the following percentage composition (lead, 82·5; antimony, 11·0; tin, 5·5; copper, 1·0) has shown that it is possible for the antimony to unite either with the tin, to form cubes of the compound SnSb, or with the copper, to form needles of the compound Cu_2Sb (Regulus of Venus). Three different pouring temperatures have been employed in this investigation—500° C., 400° C. and 300° C. It has been found that chill castings poured at the higher temperatures—500° C. and 400° C.—contain but slight traces of the tin-antimony compound, whereas chill castings poured at 300° C. contain but few of the purple needles of the copper-antimony compound. If a chill casting containing the tin-antimony compound (that is, one poured originally at 300° C.) be melted and poured at 500° C., the tin-antimony cubes are almost completely replaced by copper-antimony needles. If, however, a chill casting containing the copper-antimony compound (that is, one poured originally at 500° C.) be melted and poured immediately on arrival at 300° C., the copper-antimony needles persist. That the copper-antimony needles may, however, be replaced by tin-antimony cubes is shown by the fact that when a sample of the alloy is heated to 500° C. and allowed to cool slowly to 300° C. before pouring, cubes of tin-antimony compound are found in the chill casting produced.

It is believed that the above observations are new. I should be glad, however, to hear if reactions of a similar nature have been observed in alloys of this or other systems.

O. W. ELLIS.

University of Toronto,
Toronto, Canada,
February 9.

The Auroral Green Line.

(By Cable.)

DR. SHRUM and I have observed in the spectrum of a mixture of air and helium, with the latter in excess, a line at 5577·35 ± 0·15. Mixtures of oxygen and helium give the line enhanced approximately to one-half the intensity of each of the yellow lines of helium.

A long discharge tube was used, surrounded over part of its length with liquid air, and the best results were obtained with a pressure of about five millimetres of mercury. The line was not observable in the spectrum of purified oxygen, hydrogen, nitrogen, or helium. No mixtures of any two of these gases other than oxygen and helium gave this spectral line.

The line is narrow, very sharp, and well defined, and these characteristics, together with its wave-length and the conditions under which it is observable, point to its identity with the auroral green line.

J. C. McLENNAN.

University of Toronto,
March 10.

Demonstration of the Heating Effect of a Magnetic Field.

To demonstrate the heating effect of a magnetic field, Tyndall revolved between the poles of an electro-magnet a copper-pipe filled with an easy melting fuse: the heat disengaged in it by eddy-currents melts the fuse and the liquid metal is sprayed out in visible globules. To render the heating effect of eddy-currents even more conspicuous, it occurred to me to make the revolving body to glow, and I adopted, after some trials, the following arrangement.

I used as a rotor (Fig. 1) a copper-ball fixed to a

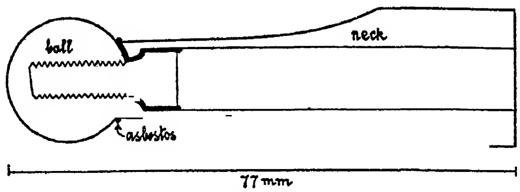


FIG. 1.

copper-neck, and insulated from it by asbestos. The rotor was fixed by the neck to the shaft of an electro-motor—the neck being sufficiently long to allow the ball to be placed in the magnetic field between the poles of the electro-magnet.

Revolving a ball 22 mm. in diameter in a field of $5·7 \times 10^3$ C.G.S. at a rate of $5\frac{1}{3}$ thousand revolutions per minute, the ball begins to glow in a dark room after $1\frac{1}{3}$ minutes, and in a fairly dark room after $1\frac{1}{2}$ minutes.

Omitting the asbestos insulation between the ball and the neck delays the beginning of the glow by about a minute.

HARALD PERLITZ.

Fyysika Instituut, Tartu, Estonia,
February 3.

The Propagation of Radio Waves over the Earth.

THE modified form of the ionic deflexion theory of wave propagation, discussed by Messrs. Nichols and Schelling (NATURE, March 7, vol. 115, p. 334), appears to have been suggested in England and the United States almost simultaneously. That the effect of the earth's magnetic field had to be taken into account in calculating the phase-velocity was pointed out in a paper on "Geophysical Influences on the Transmission of Wireless Waves" read at a joint discussion of the Physical Society of London and the Royal Meteorological Society in November 1924 and already published. The formula for the phase-velocity for transmission along the earth's magnetic field and the calculation of the critical frequencies were there given, and some consequences of these effects have been discussed in a paper communicated to the Cambridge Philosophical Society. Since the earth's magnetic field is strong enough to affect the phase-velocity to a sufficient extent, all the rotatory and double refraction effects familiar in physical optics are appreciable. But probably the most interesting possibility is that the reciprocity relation between two wireless stations may not hold, for the extra forces on the moving electrons due to the earth's magnetic field are, to a certain extent, independent of the direction of propagation of the waves and thus produce relatively different effects for the two directions of transmission.

E. V. APPLETON.

Wheatstone Laboratory,
King's College,
London, March 7.

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F R S

II HENRY WILDE (1833–1919)

HENRY WILDE would have taken a very prominent place among the scientific men of his time had his exceptional abilities not been handicapped by an obstinate and querulous disposition He had imagination, ingenuity, and considerable experimental skill, but on the other hand he was possessed by vanity, pugnacity, and contempt for anybody else's opinion In his scientific work he had a good sense of discrimination between the essential and the accidental, but in his personal relations with others, trivial grievances were magnified into serious injuries Once he complained to the Vice-Chancellor of the University of Manchester that one of his clerks had insulted him After an expression of regret and on a request for details, it appeared that the clerk, by an oversight, had omitted to put "F R S" after his name on a letter

The threat of legal proceedings was Wilde's favourite method of controversy, and he was reported to have offered his solicitors twice the usual fees on condition that they should never dissuade him from taking legal action I once asked him why he was so fond of going to law. He replied that it was out of gratitude, and explained that early in his career, while he was the defendant in a law suit, the judge put a question to him which he could not answer, but when he was thinking about the matter on his way home, he was led to the train of thought which resulted in the construction of the first dynamo-electric machine One would like to know the name of the judge and the exact nature of the question. The law suit referred to was probably that brought by the Universal Private Telegraph Company against Wilde for infringement of patent, the case was decided in his favour

During the greater part of his scientific life, Wilde was afflicted by a sense of injury, due to what he looked upon as an insufficient recognition of his claim to have invented the dynamo-electric machine This culminated ultimately in an unfortunate law suit which Wilde brought against Silvanus P Thompson, who in his well-known treatise had stated that Werner Siemens, in a communication read before the Berlin Academy of Sciences on July 17, 1868, first used the expression to designate all appliances which now pass under the collective name of "Dynamos" Wilde, on the other hand, claimed that the term was first applied to his own machine by Brooke Thompson was certainly inaccurate in his statement In the only sentence in which the expression "dynamo-electric" was used by Siemens, it denotes what we now should call "motors" It is a pleasure to add that while Silvanus Thompson won his case both in the first instance and on appeal, he afterwards revised the historical account given in his treatise, recognising Wilde's work in a manner that is not only adequate but even generous

Disregarding questions of nomenclature, there is no doubt that Wilde's paper, communicated to the Royal Society by Faraday in 1866, was the first important step in the production of electric currents on a scale which opened out the possibility of great industrial applications Stokes more than once referred, in conversation, to the great impression created at the meeting of the Royal Society when an iron wire, fifteen inches long and one-quarter of an inch in diameter, was raised to white heat and melted

Mr Haldane Gee, of the University of Manchester, in his obituary notice of Henry Wilde (Memoirs of the Manchester Lit and Phil Soc vol 43, No 5), which contains much interesting information, tells us that Wilde was the son of a working man and was apprenticed to an engineering firm at the age of sixteen. Whatever the social status of his parents may have been, his early surroundings must have been refined and cultured. Though self-taught, his language and style of writing were those of a highly educated man The extent of his knowledge of the history of science and philosophy, as well as his acquaintance with general literature, were remarkable

Wilde's contributions to technical science were both numerous and important, but in his later years practical applications interested him mainly in a financial sense. It will be remembered that when the general public was brought to realise, almost suddenly, that the electric lighting of houses would come into general use, a panic set in among the shareholders of gas companies Wilde, with clear foresight, chose the moment when the shares were at their lowest, sold his electric works and invested the proceeds in the General Gas and Coke Company This, together with the royalties he received, secured him a substantial income, and he could thenceforward devote himself to unremunerative work.

Apart from his papers on terrestrial magnetism, to which he devoted much time, and excepting the subject of aviation, Wilde concentrated his attention in later years mainly on questions of a fundamental character In these, his self-trained mind felt itself free to disregard all authority and to be guided only by his own instincts. Facts were, to him, simply illustrations to be accepted or rejected according as they did or did not fit in with his own views His firm belief in the evidence of an intelligent design in Nature, which was the basis of his religious and scientific faith, convinced him of the necessary simplicity not only of fundamental laws but also of fundamental facts Hence his absolute rejection of anything but integer numbers to express physical or chemical relationships If chemists gave fractional figures for their atomic weights, their measurements, in Wilde's judgment, were necessarily wrong, and if simplicity rules the world, atomic weights were likely to follow the same order as planetary distances, with regard to which he gave unqualified assent to Bode's Law

For the subject of the annual "Wilde Lecture" of the Manchester Literary and Philosophical Society, which he had endowed and himself delivered in 1902, Wilde selected the old-standing controversy between the followers of Newton and Leibnitz on the measurement of force To him force meant energy, and he naturally put himself on the side of Leibnitz The lecture, to which he gave the title, "On the Evolution

[1] Continued from p 343

of the Mental Faculties in Relation to some Fundamental Principles of Motion," was a great effort of special pleading, and contains references to passages in the writings of Bacon, Locke, Halley, Copernicus, De Morgan, Descartes, Newton, MacLaurin, Schopenhauer, and more modern writers As an example of Wilde's style, the second paragraph of the lecture may be quoted

"It will be universally allowed that if one of the Siminæ could be taught to enunciate a false proposition, *e g.*, that space is four dimensional, or that the twentieth century commenced on January 1st, 1900, such a creature would be much more interesting to naturalists, and be more highly valued by collectors, than any of its inarticulate companions of the forest."

Wilde had a grim sense of humour When some act of the University of Manchester displeased him, one could feel pretty sure that he would give effect to his displeasure by a benefaction to some other scientific institution, generally at Oxford or Paris. He once asked the treasurer and an important member of the council of Owens College to call on him on an important matter Hopes of a substantial endowment ran high, but they had to hide their disappointment when they found that their presence was only wanted to witness a signature or to assist at some similar trivial function. Wilde's residence stood near the top of a steep lane on Alderley Edge When bicycling came into fashion several accidents occurred at that point, and Wilde fixed on the usual danger-post a board which carried, beneath the drawing of a skull and cross bones, the legend "A stretcher may be obtained at the Hurst Cottage below when required" A picture of the post, in its surroundings and with two cyclists inspecting it, appeared in the *Daily Graphic* on September 11, 1900

Wilde received blows as cheerfully as he dealt them out It was once my disagreeable task to propose a vote of censure on him while he was sitting in the presidential chair at the Literary and Philosophical Society of Manchester He had written a letter making unjustifiable accusations against the treasurer of the Society, and some action became necessary I first gave him an opportunity of withdrawing the letter, but he refused, and when I had made my speech and it came to the vote, Wilde simply said, "I withdraw the letter," and went on with the business of the meeting "I have had many pinpricks from you, but you have also done me some kind actions," was all the reference he made to the incident after the meeting Our friendship was never affected by such incidents He might, at the end of a long discussion during one of his frequent visits to my laboratory, tell me that I was not fit to be a university professor, and a day or two later make amends by sending me a basket of beautiful hot-house grapes

Wilde's fondness for litigation has already been mentioned One might almost say that he looked upon it as a form of recreation I have before me copies of lawyer's letters filling nearly twenty pages, all containing threats of legal action against the Manchester Literary and Philosophical Society, which he truly loved and of which he was a munificent benefactor It is not necessary to enter into details with regard to them, but his dispute with the Royal Society of Arts deserves to be placed on record, and as an introduction to it I must refer to a previous incident

Wilde had given a sum of money to the Manchester Society to enable it to award from time to time a gold medal for meritorious work The Society considered it appropriate to offer the first medal to the donor Knowing his sensitiveness with regard to the discovery of the dynamo machines, they laid great stress on it in formulating the reasons for the award. Wilde was up in arms "Your Society," he told the Council, "is a body for the prosecution of pure science You have nothing to do with technical applications" He refused to accept the medal unless the Council modified their reasons for the award, emphasising his discoveries in pure science The Council did not see its way to accept Wilde's own formula and the matter proceeded no further In the following year (1900), the Council of the Royal Society of Arts decided to confer the Albert Medal on Wilde "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small" Wilde again raised objections The Royal Society of Arts, unlike the Manchester Society, was concerned with industrial applications, while the wording of their award laid stress on a principle rather than on an application This aroused his suspicion that his claim to the invention of the dynamo and its application to industrial processes was not sufficiently recognised by the Society In his reply to the letter conveying the award of the medal, Wilde wrote

"Considering that the principal object of the Society is to give encouragement to Arts, Manufactures, and Commerce, which object is prominently set forth in most of the awards of the Albert Medal hitherto made, the absence of all reference to the industrial applications of my discoveries and inventions in the terms of the award is a notable omission, and, if unrectified, will effectually preclude me from accepting the honour for which I have been designated by the Council"

Three days later Wilde wrote again to suggest a wording which he would consider satisfactory In the meantime the proposed conferment of the medal in the original terms had been published in the daily press, this resulted in a lawyer's letter, and the issue of a writ to restrain the Society of Arts from announcing the award in their own journal before some agreement had been arrived at as to the wording The Society then altered the wording It added a sentence referring to Wilde's application of his machine to search-lights and the electro-deposition of metals, and with regard to the dynamo machine, it added that the principle which formed the basis of Wilde's work is "now used in all dynamo machines" This was a fair and adequate statement, but it displeased Wilde more than ever I think, however—and I saw much of him at that time—that he was more amused than vexed when the Society sent him the medal by post instead of following their usual practice of presenting it at their annual meeting under the presidency of the Prince of Wales

The incident ended with a letter addressed by Wilde to the Institution of Electrical Engineers, in which, after declaring his dissatisfaction with the terms under

which the medal had been bestowed upon him by the Royal Society of Arts, he proceeds

"Nevertheless, the action of the Society has invested the Albert Medal of 1900 with a considerable degree of historical interest, and, in response to the recent invitation of the Council of the Institution for gifts of such objects to form a permanent Museum, I enclose herewith the Medal as a contribution to the collection"

The whole correspondence was afterwards published and freely circulated by Wilde

One of Wilde's peculiarities was his strong objection to have his photograph taken, which was a pity, because he really had a fine and expressive face "I want to be remembered by my works and not by my physiognomy," he often told me He added that on one occasion he gave way to the wishes of his wife, but having repented he had the plate destroyed A copy, however, seems to have been kept by the photographer and was reproduced in his obituary notice I cannot help regretting this disregard of his wishes

It remains to mention his extensive benefactions He gave altogether 10,000*l*. to the Manchester Literary and Philosophical Society and 5500*l* to the Académie des Sciences of Paris His endowments, during his life, of scholarships and readerships at Oxford amounted to 3000*l*, and a contribution of 1500*l* to the Benevolent Fund of the Institution of Electrical Engineers raised the total of these gifts to 30,000*l* Yet he died a comparatively poor man The residuary estate, which was bequeathed to the University of Oxford, after deducting some minor legacies, only amounted to 10,000*l*

I am afraid that this account dwells a good deal on Wilde's pugnacious peculiarities, but in spite of many acute differences of opinion, I had a very high regard for his straightforward character and attainments We always remained friends.

The Phylogenetic Classification of Flowering Plants.[1]

By JOHN PARKIN

THOUGH "the abominable mystery," as Darwin called the problem of the origin of Flowering Plants, is by no means solved, there has been before the botanical world for some years a theory of their origin which is consonant with the derivation of all forms of existing flowers from the Ranalean type Through Wieland's brilliant elucidation of the structure of the fossil Bennettitean fructification at the beginning of this century, botanists became acquainted for the first time with an unexpected bisexual seed-bearing cone, in which the two kinds of sporophylls bore the same relative position to one another on the axis as they (the stamens and carpels) *invariably* do in the angiospermous hermaphrodite flower, and further, such a cone was subtended by a number of bracts resembling a perianth The temptation naturally was great to suggest a real bond of affinity between the Flowering Plants and these Cycadean-like Mesozoic plants, the Bennettitales (Cycadeoideæ) A theory was worked out to this effect. Though the peculiar nature of the female part of the cone precludes the direct origin of the Angiosperms from the Bennettitales, the view was put forward that the two groups had diverged from common ancestors with a generalised type of flower-like cone—the *anthostrobilus*, as it was called These ancestors, it was thought, probably arose from the seed-ferns (Pteridosperms) It was further conjectured that the Angiosperms owed their being to the substitution of insect-pollination (entomophily) for wind-pollination (anemophily), and it has even been hazarded later that this type of cone, the anthostrobilus, may have been evolved in response to insect-visitation The theory also provided a resting-place for that small puzzling group of Gymnosperms, the Gnetales, and accounts for the peculiar male (morphologically hermaphrodite) "flower" of Welwitschia — the stumbling-block to those botanists who endeavour to derive the Gnetales from the Conifers, a group characterised as a whole by possessing unisexual cones

The whole speculation, which has rightly or wrongly been termed the "strobilus theory of angiospermous descent," still awaits confirmation or refutation It has with some botanists lost favour on general grounds The recent discoveries of palæobotany show that many of the main groups of vascular land plants can be traced right back to Devonian times as independent lines, and Dr. A. H Church in a recent stimulating memoir has speculated as to the possibility of these main phyla having been even differentiated in the sea independently from one another Thus it is just possible that the Angiosperms may represent such an independent line, originating from a distinct group of Algæ Their resemblance then to the Bennettitales would become merely an interesting parallelism This then may be said to be the chief criticism that can as yet be levelled against the strobilus theory Dr Scott, in his latest edition of his "Studies in Fossil Botany," sums up in favour of the theory[2] If the Angiosperms throughout the ages have been independent of any other vascular group, one wonders why obvious traces of them have never come to light in the Palæozoic rocks. It is difficult to believe that they can, as it were, have stepped out of the sea, fully differentiated, in late Mesozoic times One of the astonishing facts of palæobotany has been the sudden appearance of Flowering Plants in late Cretaceous times Dicotyledonous stems are now known, however, from lower Cretaceous rocks, and recently Mr. Hamshaw Thomas has brought to light some remarkable fossil fruits (the Caytoniales), resembling those of Angiosperms, from the middle Jurassic Possibly then ere long some fresh light may be thrown on the problem.

It is important to recognise that the classification of Angiosperms based on the Ranalean families does not stand or fall with the Bennettitalean theory If the latter be disproved, the former is only affected to the extent that it has no fossil group upon which to fall back All modifications of the flower can still as before be derived from a magnolia-like one The Bennettitalean theory has helped to focus the attention

[1] Continued from p 342

[2] 3rd edit vol. 2, London, 1923, pp 427-430

of botanists on the Ranales Once they have grasped the possibilities of making this group of families a basis upon which to found a new system of classification, they will not be likely to return to the Englerian view of the primitive flower, should the theory have eventually to be discarded. In this way it will have served a useful purpose

In recent times certain botanists, notably Bessey of America and Hallier of Holland, have endeavoured to supersede Engler's classification by introducing systems of their own based on the Ranalean families Hallier was perhaps too changeable and prolix to attract the attention he deserved Bessey was more thorough and logical. The writings of both suggest, however, that their attempts at new systems were more the outcome of book-work than of the actual examination of the living or dried specimens It is otherwise with Hutchinson He has not only at hand an unrivalled collection of plants, but also has behind him some twenty years' experience of comparative work in this line. In his first "Contribution" he sets forth his principles,[3] which are essentially those of Bessey, and, we surmise, they will be generally acceptable to those botanists who have ceased to believe in the primitive character of the amentiferous flower He points out that the evolution of the flower among existing Angiosperms has taken, broadly speaking, either an upwards or downwards course This in terms of function may be interpreted as either greater adaptation for insect-pollination or a change-over from entomophily to anemophily and in terms of structure as either great modification and advancement in the shape of the corolla or the complete loss of this organ as no longer required for insect-attraction.

These two evolutionary changes may be considered to have been continually in action in the past and to be still in operation The older the petalous (entomophilous) group, the more apetalous (wind-pollinated) forms will it have given off This is exemplified by the fact that the Apetalæ (in the taxonomic sense) have probably been derived as a whole from the Polypetalæ (petals free), a group generally considered earlier and more primitive than the Sympetalæ (petals united) These latter, of mixed polypetalous ancestry and in most cases highly specialised for insect-visitors, present few anemophilous forms The plantains (Plantaginaceæ) and our native ash (*Fraxinus excelsior*) alone come to one's mind. In the former the corolla has not actually disappeared, though scarcely functional. The latter has naked and often unisexual flowers, though certain species of this genus and the rest of the family (Oleaceæ) have hermaphrodite flowers with a corolla Perhaps Englerians would have held the flower of the ash as primitive if it had stood alone As it is, no botanist doubts but that this tree has had petal-bearing entomophilous ancestors

The paucity of apetalous derivatives from the Sympetalæ may be considered to be due to the shortness of geological time since these forms appeared At the same time it is well to bear in mind the possibility that the more highly specialised for entomophily a flower becomes, the more difficult it may be for it to change over to anemophily Hutchinson uses these ideas of progressive and retrogressive evolution as applied to the flower in his proposed scheme for the rearrangement of the earlier dicotyledonous families (Archichlamydeæ) So far as possible, in any circle of affinity, after fixing on the basal group, he first treats of the families showing corolla-advancement, *i e* those increasingly adapted for entomophily, and then the families showing corolla-reduction, *i e* the degraded forms which through force of circumstances have had to take to anemophily

A restrictive attitude is adopted by Hutchinson in respect to the value given to the various grades of classification, such as order,[4] family, and genus The groups thereby become more natural and less unwieldy An example will illustrate his mode of procedure Engler's old cohort, Ranales, comprising about 15 families, is split into five orders—the Magnoliales, Anonales, Laurales, Ranales, and Berberidales His Magnoliales embrace practically the genera contained in the old family, the Magnoliaceæ This he breaks up into three families—the Magnoliaceæ, Winteraceæ[5] (Drimys and its associates), and Schizandraceæ The Magnoliaceæ now becomes a very natural family, composed of the genera Magnolia, Michelia and their close allies, together with the Tulip-tree (Liriodendron) The Ranales in the restricted sense contain the Ranunculaceæ (unaltered in composition, but its taxonomy improved upon that occurring in the "Pflanzenfamilien"), the Nymphæaceæ and the Cabombaceæ, formerly a tribe of the foregoing but now raised to family rank

In some ways we regret the use of Ranales in this restricted sense, though it is in accordance with taxonomic rules. This term and its adjectival form, Ranalean, have been employed in recent times in the wide sense, and especially with respect to the Magnolian flower, hence confusion may be apt to arise in the near future This, of course, can be avoided by strictly defining one's terms A new embracing term is now wanted for the families composing, say, the old Ranales together with the Dilleniaceæ Might not also a substitute be found for the clumsy term, Archichlamydeæ—one in keeping with Sympetalæ, which Hutchinson apparently intends to use instead of Metachlamydeæ? The revival of the Choripetalæ of Eichler is a possible suggestion

The view that the tree preceded the herb is one that has made headway in recent years The reverse was perhaps vaguely held last century Hutchinson makes full use of this new idea, though at the same time prepared to recognise that here and there the opposite may have taken place, namely, herbs giving rise to woody forms He thinks, for example, that both Clematis and Berberis have had a herbaceous origin. This is distinctly interesting to plant anatomists It may be expected that the wood of shrubs and trees evolved from herbs will show structural features distinct from the wood of trees which have come from ancestors primitively arboreal in habit. In his proposed rearrangement of the Archichlamydeæ he shows graphically by means of a phylogenetic tree[6] the possibility of

[3] *Kew Bulletin*, 1923, p 73.

[4] To the older field botanists familiar with the term, *natural order*, now superseded by that of *family*, the use of *order* in this wider sense may be confusing It was adopted in place of *cohort* by the International Botanical Congress of Vienna, 1905 Presumably there were strong reasons for this change, but they are not apparent to the present writer

[5] *Kew Bulletin*, 1921, p 185

[6] *Kew Bulletin*, 1924, p 118

deriving this assemblage of families as two distinct branches—one from the tree Magnoliales and the other from the herbaceous Ranales. Each branch in its ramifications is depicted as giving its quota to the "Apetalæ," the tree-line supplying chiefly the Amentiferæ, and the herb-line such alliances as the peppers, docks, and chenopods. In one case the arborescent habit continues dominant, though herbs eventually arise in the highest forms, *e.g.* in the Papilionaceæ; in the other case herbs prevail, though shrubs and trees occasionally make their appearance. This novel and suggestive idea requires thorough sifting to see how far it may be considered sound. In this connexion, we may here point to his treatment of the family, Saxifragaceæ, as defined in the "Genera Plantarum" and "Pflanzenfamilien." Most will admit that this family, as at present constituted, is cumbersome and unnatural. Hutchinson brings his tree-herb speculation to bear upon it and cleaves it in two. The herbaceous Saxifrages and their allies are placed along with the Crassulaceæ in the order Saxifragales, derived directly from the Ranales (in the strict sense); while the remainder of the old family—the bulk of it, in fact—is split into the Escalloniaceæ, Grossulariaceæ, and Hydrangeaceæ, and as such compose part of his new order, the Cunoniales, derived directly from the arborescent Dilleniales. In consequence, the old family is separated into two sections placed far apart. In this connexion one would like to know how he views the hitherto supposed relationship between Spiræa and Astilbe. If he still recognises it, then no provision appears to be made for it in his scheme. He derives the Rosaceæ, and presumably the genus Spiræa, from the woody Dilleniales; whereas the Saxifragaceæ, as he now limits the family, to which Astilbe should naturally belong, are obtained from the herbaceous Ranales. He partly saves himself in a footnote[7] as follows: "It is probable that some herbaceous *Rosaceæ* have not had a common origin with their ligneous associates." But among the Spiræas are many ligneous forms. These will still require explaining.

In conclusion, it may be thought that the introduction of a new classification of Flowering Plants is a task of too great importance to be entrusted to a single individual. Some may hold it to be a matter for a body of experts. Taxonomy, however, in the past has not progressed in this way. Systems have largely been the result of individual effort. Some have become authoritative, others have not. A single mind tends to keep throughout a consistent value for the various grades of classification. The whole effort will show on completion a symmetry and balance which it otherwise would not possess. This is far from saying that a new system should not be subjected to searching criticism while it is yet in the process of elaboration.

[7] *Kew Bulletin*, 1924, p. 117.

Obituary.

RIGHT HON. SIR CLIFFORD ALLBUTT, K.C.B., F.R.S.

THE sudden and quite unexpected death, after a few minutes' distress, early on the morning of February 22, of Sir Clifford Allbutt, Regius professor of physic at Cambridge since 1892, robs British medicine of its acknowledged leader, who from his scholarly accomplishments recalls Samuel Johnson's description of William Heberden the elder (1710-1801) as "Ultimus Romanorum, the last of the learned physicians." He was indeed remarkable for his wide knowledge not only of modern but of ancient medicine, and for the broad horizon of his conception of the relations of medicine and how its future course should be directed. Thus he was ever insistent on the importance of a sound general educational basis on which medical studies should be engrafted, and he held strongly that universities should provide a liberal education and not lay themselves out for the more utilitarian qualification for the practice of any art or trade, and should not compete with hospital schools. His high standard was shown in a work—the result of many years' research—on "Greek Medicine in Rome" (1921). Since 1888 he had advocated the necessity for the study of comparative medicine and pathology, and happily he lived to see his own University start an Institute for this branch of research, and appropriately he was the first president of the Section of Comparative Medicine at the Royal Society of Medicine.

The wisdom of Allbutt's selection as Regius professor of physic in 1892, and of the departure from the existing custom of appointing a resident physician, has been signally justified. By a similar change at Oxford in 1905, by which Sir (then Dr.) William Osler was transplanted from the Johns Hopkins Hospital, Baltimore, the two older universities were represented by a pair of Regius professors with a world-wide reputation, such as had never before fallen to their lot, for clinical experience and scientific attainments. There were, indeed, some curious coincidences in the lives of these two friends: they became members (1878) and fellows (1883) of the Royal College of Physicians in the same years, gave the Goulstonian Lectures in successive years, and, though these are the almost natural duties of such Regius professors, delivered the Harveian Oration at the College, and edited successful "Systems of Medicine" which have gone through two editions and are destined for a third in the near future by other hands.

Thomas Clifford Allbutt, the son of the Rev. Thomas Allbutt, Vicar of Dewsbury in Yorkshire and friend of Charles Waterton the naturalist, was born on July 20, 1836, and was named Clifford after his godfather, an artist, who married his father's sister, and whose son Edward Clifford painted the portrait of Lady Allbutt hanging in his study at St. Radegund's, Cambridge. Before the Allbutts' time, Patrick Bronte had been one of the curates at Dewsbury, and they knew his famous daughters well; Sir Clifford regarded it as a sacred duty to contradict the impression given in Mrs. Gaskell's Life of Charlotte Bronte that the family were isolated and not in touch with the country people.

Educated at St. Peter's School, York, he went up in 1856 as a classical scholar to Gonville and Caius College, Cambridge, and his name was the only one in the first class of the Natural Science Tripos for 1860 with distinc-

tion in chemistry and geology Entering on November 5, 1858, as University students then usually did, the Medical School of St George's Hospital, and while a clinical clerk for Dr H. Bence Jones, F R S, secretary of the Royal Institution and an ardent chemist, he became interested in acute aortitis, a subject which afterwards much engaged his attention in connexion with his view of the causation of angina pectoris With Lockhart Clarke, who was then working at the hospital, he was on friendly terms, and was influenced by his microscopical investigation of the central nervous system, while to J W Ogle he ascribed the stimulus to apply the ophthalmoscope to general medicine He took the M B, Cambridge, so early as 1860 and the M D eight years later After leaving St George's he spent some time in Paris following the teaching of the great Trousseau, and about 1862 settled down to practice in Leeds, where he was attached to the Royal Infirmary (1864–1884), and had a most extensive consulting practice in Yorkshire and the North of England, while at the same time carrying out much research and literary work

In 1889 Allbutt left Leeds for London on accepting a Commissionership in Lunacy, and thus became associated again with Sir James Crichton-Browne, with whom he had worked at the West Riding Asylum, but his stay in London was cut short in 1892 when, after first refusing, he was persuaded to succeed Sir George Paget as Regius professor of physic in the University of Cambridge For the remaining thirty-two years of his extremely active life, though taking a prominent part in the medical activities of the University and of the country in general, sitting on commissions and numerous committees, he was no longer driven by the exigencies of a busy consulting practice, and this spare time he utilised to the full and to the great advantage of his medical brethren A notable service in this respect was the editing of a "System of Medicine" (1896–1899) in eight volumes, which was the lineal successor to the "System of Medicine" (1866–1879) in five volumes edited by Sir J Russell Reynolds Allbutt's "System" passed into a second edition (1905–1911) in eleven volumes, and received a well-deserved welcome from the medical profession

It is difficult to summarise Sir Clifford's contributions to medicine, for in addition to his philosophically minded addresses and historical work, he ranged far and wide over the province of medicine But his name will be more especially connected with certain advances, in the first place, he did much to introduce the now general use of some instrumental methods in medicine, thus in 1868 he introduced the present form of clinical thermometer in place of the long and unwieldy one previously available, and made many observations on the temperature of the body in health and disease, reading a paper in 1873 on the effect of exercise on the bodily temperature to the Royal Society, of which he was elected a fellow in 1880, and was subsequently councillor for two sessions and vice-president.

In 1871 there appeared Allbutt's epoch-making work, "The Use of the Ophthalmoscope in Diseases of the Nervous System and of the Kidneys, and also in certain other General Diseases," wh ch, in addition to giving his own extensive experience, covered the literature, as his published work always did, in an admirably complete manner. It is worth noting that this monograph appeared in the year of the death of the original inventor of the ophthalmoscope—Charles Babbage (1792–1871)—and that its practical use, and of Helmholtz's later modification, in medicine, though suggested by Sir Spencer Wells, is largely due to the advocacy of Allbutt and of Hughlings Jackson He also did much to bring in the now familiar use of the stomach tube and the sphygmomanometer for the estimation of blood pressure

Allbutt's most consistent work was on diseases of the cardio-vascular system, in 1868 he gave one, if not the first, of the descriptions of syphilitic disease of the cerebral arteries, buried in the now extinct St George's Hospital Reports, two years later he insisted on the effects of overwork and strain on the heart and great vessels, published in the same series, since 1895 he had described hyperpiesia or high blood pressure of obscure origin, and insisted that it was not secondary to arterial disease or necessarily to nephritis Angina pectoris has been variously explained, the most popular view being that it is due to disease of the coronary arteries of the heart, but since 1894 he argued that its real cause is disease of the first part of the aorta His observations on these various subjects were collected in 1915 in his "Diseases of the Arteries, including Angina Pectoris" (2 volumes, Macmillan), and there is in the press a supplementary work on "Arteriosclerosis: A Summary View." Though he wrote much, he did so with a very critical and careful eye, and, as mentioned in his "Notes on the Composition of Scientific Papers," now in a third edition, he usually made four drafts at least before the manuscript was ready for the printers. The finished charm of his writings aptly corresponded to his personality

A wide reader, he was most generous in recognising good work by unknown men, and though advanced in years always maintained the mental elasticity of youth This was, indeed, in keeping with his physical activity, for, like his friend the late Sir Hermann Weber, he was until well on in years a keen Alpine climber, as he wrote to the *Times* a week or so before his death about the proposed alteration, artistically for the worse, of the bridge over the Rotha's "living wave" at Grasmere, he had walked in the Lake District almost every year since he was fourteen, and he rode a bicycle or tricycle last year With a now somewhat old-fashioned courtesy he was independent, and on occasion spoke out vigorously against what he thought wrong, for example, his castigation of the practices of some gynæcologists in his "Visceral Neuroses" (1884), and more recently his disapproval of psycho-analysis What would be eagerly sought as honours by many men came by natural right to this beloved physician, and deservedly the list is too long to detail They were accepted with pleasant expressions of modesty and appreciation, but it could not but be felt that the givers of honorary degrees and medals really honoured themselves by their award He was made K.C B in 1907, and a Privy Councillor in 1920, and could, had he desired it, have been made a peer English-speaking medicine can well be proud of its great and broad-minded leader.

HUMPHRY ROLLESTON

THE death is announced from America of Dr Joseph Clark Hoppin, the well-known classical archæologist Dr Hoppin was a graduate of Harvard University, and at one time was professor of classical archæology in Bryn Mawr College, Philadelphia, but relinquished this post to devote himself to research He was a student at the American School of Archæology at Athens in 1892-3, and took part in the excavations carried on in the Argive Heræum between the years 1892 and 1895 When the work of excavation came to an end, he took charge of the Department of Ceramics and was responsible for the examination and classification of the large quantity of pottery in the Museum at Athens which had been obtained from the Heræum site His "Handbook of Attic Red-Figured Vases," a standard authority, appeared a few years ago, and his book on "Greek Black Figured Vases" appeared only at the end of last year He had devoted himself for many years to the formation of a collection of classical antiquities, and it is said that his collection was perhaps the most complete of any in private hands in the United States The value of his work had been recognised in Great Britain by election to honorary membership of the Society for the Promotion of Hellenic Studies, an honour which he greatly appreciated According to a sympathetic notice by one of his former colleagues in Athens, which appeared in the *Times* of February 4, he had projected further excavations, at his own expense, shortly before his illness, in the Argive Heræum

THE *Chemiker Zeitung* records in a recent issue the life and work of Dr Richard Escales, who died on September 9 at Munich Dr Escales' name will be remembered chiefly in connexion with his work on explosives He was born on July 8, 1863, at Zweibrucken, where his father owned a textile factory. After studying at Wurzburg, Munich, Erlangen, and Zurich, he graduated in 1886, and for a while was engaged in his father's business Somewhat later he returned to Munich in order to undertake the study of explosives in the laboratory of Adolph von Baeyer, and in 1898 he discovered *ammonal*, a high explosive containing aluminium powder, which played a prominent part in the War He sold the patent rights of this discovery for an inconsiderable sum in Vienna In 1902 he founded an experimental station for explosives at Munich, where during the War he acted as director of the department of "Minenwerfer" He compiled a seven-volume standard work on explosives and was the founder and publisher of the *Zeitschrift fur das gesamte Schiess- und Sprengstoffwesen*

WE regret to announce the following deaths·

Dr J Cleland, F R S, from 1877 until 1909 professor of anatomy in the University of Glasgow, and afterwards emeritus professor, on March 5, aged eighty-nine

Dr Willet G Miller, provincial geologist of Ontario, known for his work on the pre-Cambrian and economic geology of Ontario, on February 5, aged fifty-eight

Dr J A Ormerod, registrar since 1909 of the Royal College of Physicians, and Harveian Orator in 1908 and Lumleian Lecturer in 1914 of the College, on March 5, aged seventy-six

Sir William Peck, Director of the Edinburgh City Observatory, Calton Hill, on March 7, aged sixty-three

Dr J Ward, professor of mental philosophy and logic in the University of Cambridge since 1897, on March 4, aged eighty-two

Current Topics and Events.

MUCH satisfaction is felt in scientific circles that the Prince of Wales has consented to occupy the presidential chair of the British Association for the meeting to be held at Oxford next year, either from July 28 to August 4, or from August 4 to August 11 At a meeting of the General Committee of the Association on Friday, March 6, Sir Ernest Rutherford, who was in the chair, reported that the Prince had intimated his willingness to accept the presidency, and he was, therefore, nominated by the Council to the Committee and elected unanimously The Prince Consort was president of the Association for the meeting held at Aberdeen in 1859, but since then no other member of the Royal Family has filled that office British science is greatly honoured by the consent of the Prince of Wales to act as president, and his knowledge of the resources and needs of the Empire is so extensive that whatever he may say in his address at the Oxford meeting will have wide influence upon both science and the community

A PAPER by Sir Arthur Schuster, "On the Life Statistics of Fellows of the Royal Society," has just appeared in the Proceedings, and at last week's meeting of the Society the author himself gave an interesting summary of conclusions Previously, the subject had been studied by General Strachey, who, in 1892, communicated a paper based on a statistical examination of the average age of the 15 fellows annually elected, their probable duration of life, relationship to an eventual maximum strength of fellowship, and other considerations The point whether or not a small increase in the number of annual elections is required, in view of the larger scientific output of the country, has been discussed in recent years, but without bringing any change of procedure The number of fellows of the Society at the beginning of 1848, when new statutes came in force, was 768 In consequence of the restriction in the number annually elected, this total was diminished by more than a hundred in the first ten years, by 1912 the maximum had become 455. Since then the numbers show a steady decline On January 1, 1923, there were 439 fellows As regards age at election, Sir Arthur remarks that it is difficult to gauge the effect of the War, but probably it was appreciable His impression is that the younger men were kept back in their scientific work even when they were not actually in the field; while some of maturer age were substantially assisted in obtaining the fellowship by their War work The youngest man elected into the Society since 1847 was John Lubbock (afterwards Lord Avebury), who entered at the age of twenty-four.

BROADCASTING in Great Britain on a regular and commercial basis started at Marconi House in London in November 1922 The aerial work of the new 2 LO station has been erected on the roof of the Selfridge building in Oxford Street There are two towers of the lattice type, the top of each being about 250 feet above the roadway The towers are entirely self-supporting, no guy wires being used The aerial is of the two-wire type, the distance between the wires being 15 feet, the wires being connected to an insulator on the roof of the apparatus room by two large cage connectors The aerials are made of nineteen strands of No 16 bronze wire and are very heavy Strings of eight shackle insulators serve to spread and anchor the leading-in cages The machines installed in the power-house are direct coupled motor generator sets running from the supply mains Eighteen kilowatts is taken from the mains Some of this power is needed for the master oscillators which maintain the frequency of the carrier wave perfectly constant A certain amount of power also is required for the filaments of the many oscillating, modulating and rectifying valves, as well as for the ordinary losses in the machines The amount of power radiated into space is about three kilowatts, and this is the rating of the station The greatly increased power and the greater size and height of the aerial will more than double the range of the present 2 LO broadcasting station The studio, which has always been entirely distinct from the transmitting apparatus, will remain at the B B C headquarters at Savoy Hill, W C.2 As before, it will be connected with the transmitter by special underground cables The new station will shortly be in regular operation, for the experiments already made have proved extremely satisfactory It will be one of the finest broadcasting stations in the world

SIR ARTHUR KEITH, in his discourse at the Royal Institution on Friday evening, March 6, concerning the rate of man's evolution, described the difficulties in the study of this subject due to the varying stature of men and women among all races of mankind, entailing the measurement of many thousand individuals In searching the ancient burial-places of England, it is found that the people buried in ancient tombs differed in height in the same manner as at the present time It may be said that there has been no great change in the stature of the inhabitants of these islands since the close of the Ice Age The mean average of the modern Englishman of 5 feet 6 inches may be taken as the pivot on which the scales of stature have been balanced for thousands of years This was shown from a study of fifty ancient skulls from English graves carried out in 1914–15 The evidence obtained from certain fossil remains discovered at Galley Hill in 1888 points to an antiquity of man of no less than 100,000 years The facts which have been accumulating for some years past on the continent of Europe confirm this conclusion The discovery of fossil remains made in South Rhodesia in 1921 has disclosed a more primitive human type, but its age has not yet been definitely fixed By studying the facts which arise from the discoveries made in various parts of the world, anthropologists are able to form an opinion as to the rate at which man has come by the present characters of his body and brain, and the evidence which has been accumulating leads them to the conclusion that the evolution of man has been more rapid than many have hitherto believed

THE China Indemnity (Application) Bill passed its second reading in the House of Commons on March 3 without a division, and was referred to a standing committee of the House The debate was interesting and informing, and as such contrasted favourably with the second reading of the Bill brought in last May by the late administration Mr McNeill's accurate and well-marshalled knowledge of the facts, and his conciliatory attitude, made an admirable impression not only on the opposition, who objected to the changes in personnel made in the contemplated advisory committee, the places of Mr Bertrand Russell and Mr Lowes Dickinson being taken by Prof Southill and a business representative, but also on the members of his own party, who contended that the best expenditure of the fund would be on railways Mr MacDonald in a convincing speech made short work of this contention, while admitting the value of railways in developing national resources He urged that, in this case, the insufficiency of the sums available, the troubles, complexities, and negotiations which would be involved even in capitalising the fund for such purpose, and the psychological effect on the Chinese of so using the fund rendered such a project impracticable

IN Mr McNeill's opinion the phrase in the China Indemnity (Application) Bill "educational or other," which describes the purposes of the fund, should be interpreted to mean that the object must be something in the nature of education, or, at all events, it must be something which is not absolutely divergent from the main idea Since, however, notwithstanding this opinion, divergent purposes were pressed on the House, this point, with Mr McNeill's concurrence, will be decided in the standing committee It may be hoped, therefore, that Mr Somerville's amendment, "educational, medical or other similar purposes," will be accepted These words evidently meet the views which Mr McNeill expressed, and their adoption would relieve the advisory committee of an invidious task As to the constitution of this committee, a present member of it characterised it as "derisory" from a Chinese point of view Though its object is educational, the Board of Education has no concern whatever in its membership, no medical man has a seat, and, if trade interests are not to be pressed, the inclusion of a Board of Trade official seems undesirable Besides that, the other members are so occupied with public or private work that the time and attention they would be able to devote to this important work must be limited, and, considering the opportunity of national service which the fund offers, may be exiguous

THE report of the executive committee of the Empire Cotton Growing Corporation, submitted at the

meeting of the administrative council held on February 25, has underlying it a tone of expectation of a great increase in cotton production in the tropical and subtropical colonies Indeed, many signs point in this direction, and it is a matter of vital importance to the British Empire to grow as much of its own cotton as possible Mr Milligan, formerly Inspector-General of Agriculture in India, and now in charge of the work of the Corporation in South Africa, gives an interesting account of this There will be fifteen men working at cotton problems this year, as against four in 1924 Rhodesia, where the greatest possible interest is being taken in cotton, has so rapidly expanded its area under this crop that difficulties are arising in respect to ginnery accommodation Nigeria is about to start Government farms for the supply of seed The Corporation has appointed a cotton breeder to work in the Sudan Nyasaland has obtained a reduction in railway rates upon maize, which will form the necessary secondary crop for a rotation, and so on The evidence of the great interest now being taken in Empire cotton, and of the expansion of its cultivation, is growing more marked every day

COL PURVES, the Engineer-in-Chief of the Post Office, read an interesting paper to the Institution of Electrical Engineers on the "Post Office and Automatic Telephony" on March 5 A general history was given of the development of automatic exchanges The system actually adopted by the Post Office is a development of the Strowger system, now called the "Director System" This system was devised by the Automatic Telephone Manufacturing Co of Chicago, and, on the whole, it was considered better than the other systems The electric power required for an exchange of 10,000 lines is provided by two 50-volt batteries each of 10,000 ampere-hour capacity The requisite current at peak load will exceed 2500 amperes When a subscriber has finished dialling his instrument he hears immediately the "ringing tone" which tells him that the required subscriber is being rung up, or the "busy tone" which tells him that he is engaged The extreme complexity of modern automatic circuits and equipment is illustrated by the fact that a single automatic switching unit of 10,000 lines comprises no less than 5 million contacts Any one subscriber in an exchange of this size can obtain connexion with any other subscriber by 240,000 different linkages To reach all the subscribers in his unit he has 2400 million different linkages at his disposal When we consider the large number of other exchanges he can get in contact with, the number of linkages is enormously increased Graduated courses of instruction are now being given to the skilled workmen who will maintain the exchanges in working order The inspectors and engineers who will have to be responsible for the mechanism and the efficiency of the service are also being specially trained

COL PURVES, in his paper referred to above, points out that the modern automatic calling dial is a remarkably simple piece of apparatus considering the immense complexity of the machine which it controls This simplicity is the result of a long period of evolution since some one in the Automatic Electric Co first had the happy thought of making a rotating disc with finger holes for the purpose of sending the trains of impulses required for the Strowger automatic system The master patent secured a monopoly for this device from 1898 to 1912 During this time a great amount of ingenuity was expended in inventing other signalling devices which would not infringe this patent During all this period an old and forgotten telegraph device, invented by Cooke and Wheatstone not later than 1839, anticipated in all essential respects the terms of the master patent It was found during a clearing up of an old storeroom of the General Post Office in 1913, when the master patent had just expired It anticipated all the explicit claims of this patent It is curious that a patent controlling such large commercial interests, and considered unassailable for fourteen years, should have been so completely anticipated by the earliest pioneers of telegraphy

D N PRIANISHNIKOV, the eminent Russian professor of agriculture, whose thirtieth anniversary of his scientific work is being celebrated in Moscow during this month, was born in 1865 in Kiachta, S E Siberia After completing his course at the school at Irkutsk he entered the University of Moscow, but soon left it to take up studies in the Agricultural Academy at Petrovskoje, near Moscow, in 1888 he passed his final examinations, and was offered a post-graduate scholarship In 1891 he was sent abroad to study the agricultural chemistry and physiology of plants, mainly in Germany, with Prof Schulze In 1891 he was appointed lecturer, and in 1895 professor of agriculture in the Agricultural Academy of Petrovskoje, a post which he still holds, so that through his laboratories passed many hundreds of Russian agricultural specialists In his scientific work Prof Prianishnikov approaches the views and ideas of Bussengo, while his thorough training in the physiology of plants by one of the ablest botanists of the last century, K Timirjazev, and in chemistry by G Gustavson, enabled him to elucidate a long series of most complicated problems, mainly concerning fertilisers and manures and their physiological effects His dissertation for the doctor's degree, on the dissimilation of proteins in connexion with breathing and assimilation of carbon dioxide, which appeared in 1899, has been followed by numerous other works, about 200 in number, mainly in Russian and German agricultural periodicals. Two of his books, a course of agriculture, and a handbook on fertilisers and manures, are amongst the best of their kind, the latter having been translated into Polish and German The influence of Prof Prianishnikov's works and of his teaching on the progress, especially of research work, in Russian agriculture cannot be overestimated Hundreds of his former pupils, with whom he always keeps in touch, have been and still are working in different parts of Russia, developing his ideas and accumulating scientific data For an agricultural country like Russia, scientific workers

of Prof. Prianishnikov's type must be (if not always are) considered amongst the principal factors in the progress of the country

IN the official report, issued by the Textile Institute, of Proceedings of the first Empire Textile Conference (held at the British Empire Exhibition at Wembley in Whit-week 1924) accounts are given by the Directors of the Cotton, Woollen, and Linen Research Associations of the present position of scientific research in textiles and of the advantages that must necessarily follow from persistent application of scientific method to problems of the trade Numerous examples are given of spinning, weaving, and finishing problems which are now being investigated by the research associations, and attention is directed to the unlimited field for further research on matters the solution of which will be of the utmost national and Imperial importance from the points of view of the grower of the raw material, the manufacturer and the user In addition, the first part of the report contains sixteen papers dealing with exceedingly wide interests, including Empire supplies and consumption of wool and cotton, the possibilities of the British silk trade and the statistics of the textile export trade It is pointed out that the rapid increase in wool consumption during the last twenty years has been accompanied by an enormous decline in wool production, and an appeal is made to our great overseas Dominions to rectify this lack of proportion The vast economic importance of the cotton trade is referred to, and it is emphasised that as this is the largest manufacturing industry in Great Britain, the importance of increased Empire production of raw cotton, upon which the stability of this great industry must ultimately depend, is a matter of grave concern if the trade is to retain its pre-eminent position in the world's markets The decline of the British silk trade in the last fifty years has been considerable, although the Empire demand is sufficient to warrant a four-fold expansion of British trade in this material The second part of the report contains eleven scientific papers on the physical and physico-chemical problems relating to textile fibres, and a discussion thereon (held in conjunction with the Faraday Society), an account of which appeared in NATURE for July 5, 1924, p 27

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Sir J J Thomson at the ordinary meeting of the Institution to be held on Thursday, March 19, at 6 P M The presentation will precede the reading of Mr S Evershed's paper on "Permanent Magnets in Theory and Practice"

THE Society of Glass Technology has established a small Research Fund for the purpose of promoting research in subjects related to glass technology Grants from this fund will be made to assist in conducting specified items of research approved by the Council of the Society Applications should be addressed to the Secretary, Society of Glass Technology, Darnall Road, Sheffield

THE annual prize of the American Association for the Advancement of Science for the 1924 meeting at Washington has been divided and awarded as two prizes of five hundred dollars each, to Dr L R Cleveland, of the Johns Hopkins School of Hygiene and Public Health, for his work on the physiology of termites and their parasites, and to Dr Edwin P Hubble, of the Mount Wilson Solar Observatory, for his work on the nebulæ

THE Hon W G A Ormsby-Gore, M P, Under-Secretary of State for the Colonies; Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, and Sir Richard Gregory will be the principal guests at the annual dinner of the National Union of Scientific Workers to be held at the Adelaide Gallery (Gatti's Restaurant), King William Street, Charing Cross, on Thursday, March 19 The president of the Union, Prof G H Hardy, will be in the chair

THE Fison Memorial Lectures, which have been established in memory of the late Dr A H Fison, lecturer in physics at Guy's Hospital Medical School, and Secretary of the Gilchrist Educational Trust, will be inaugurated on Thursday, May 7, when the first lecture will be given by Sir J J Thomson, Master of Trinity College, Cambridge, who will take as his subject, "The Structure of Light" The Right Hon The Earl of Balfour will preside at the meeting

THE Huxley Medal of the Royal Anthropological Institute has been awarded to Sir William Ridgeway, Disney professor of archæology in the University of Cambridge, in recognition of his services to anthropological science, particularly in connexion with the study of the archæology of the Mediterranean area Sir William Ridgeway, who was president of the Royal Anthropological Institute in 1908 and 1909, will deliver the Huxley Memorial Lecture in 1926 The Huxley Memorial Lecture for 1925 will be delivered by Sir Arthur J Evans in November next

LIEUT-GENERAL SIR WILLIAM B LEISHMAN, Director-General, Army Medical Service, Hon. Physician to the King, Sir Richard Lodge, professor of history, University of Edinburgh, and Mr William Rothenstein, Principal of the Royal College of Art, South Kensington, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

THE spring conversazione of the staff of the Natural History Museum was held in the Board Room on March 4, and attracted the usual large attendance of members and visitors On this occasion most of the exhibits were selected to illustrate desert conditions and the effect of desiccation They included fulgurites (lightning tubes), desert roses, and etched pebbles (the cause of the peculiar markings of which still remains an unsolved problem), Coleoptera, Diptera, and Lepidoptera, illustrating the development of desert colour, hares, rats, mongooses, and birds, showing the effect of desert environment, lizards illustrating modifications in the scales, eyes,

and feet, and desert plants showing the development of spines and prickly leaves as a protection against thirsty and hungry animals Among the exhibits was a remarkable specimen of *Helix desotorum*, the common desert snail of Egypt, which was fixed on a tablet in the Museum in March 1846, and was found in March 1850 to be still alive after four years in a Museum case without food or moisture The snail became torpid in October 1851, and was found to be dead in May 1852 Among the general exhibits may be mentioned specimens illustrating a recent study of the occurrence of Gongylonema in Italy by Dr L W Sambon and Dr H A Baylis

A JUNIOR scientific assistant is required by the Admiralty for research work Candidates must possess an honours degree in physics or its equivalent, have a good knowledge of general physics, with some experience in research Applications should be sent to the Secretary of the Admiralty (C E), Whitehall, S W 1

THE Experimental Department of H M Signal School, Portsmouth, invites application for a junior scientific assistantship from holders of an honours degree in physics or its equivalent Applications should be sent, with particulars of qualifications and with testimonials, to the Secretary of the Admiralty (C E), Whitehall, S W 1, not later than April 7

WE have received from the Castner-Kellner Alkali Co, Ltd, a pamphlet on sodium peroxide This compound was discovered by Gay Lussac and Thenard about 1810, but it was not until 1891 that it was manufactured on a large scale The properties are described and the method of using the substance for bleaching purposes is set out in some detail Useful tables of acid densities, etc, are also included in the booklet

AN interesting tour in the Dordogne and Vézère Valleys during the Easter vacation (April 9-25) has been organised by Prof Patrick Geddes It will include visits to the principal prehistoric sites and caves in the neighbourhood of Les Eyziès under the guidance of Dr Peyrony, the curator of the Musée Archéologique, who will also conduct the party around, and demonstrate, the collections in the museum Dr Peyrony has recently published an account of the investigations carried out by himself in company with L'Abbé Breuil and Dr Capitan at Les Combarelles, and this opportunity of visiting the classical sites of palæolithic art and culture under his guidance should appeal to all who are interested in prehistoric archæology The second part of the tour will be devoted to a series of excursions for the purpose of the study of the geography and history of the most attractive portions of the Dordogne Valley, Domme being taken as the centre These excursions will be conducted by M Paul Réclus Particulars may be obtained from Miss M M Barker, 152 Abbey House, Victoria, S W 1

THE Women's Electrical Association has been formed with the immediate object of promoting the wider use of electricity in the service of women, and a large and representative council has been formed to guide its activities Lectures and demonstrations of the applications of electricity are in hand, and the study of electrical applications in universities, colleges, and schools, particularly in relation to domestic subjects, is to be promoted It is also proposed to institute a junior section which will be more especially concerned with girls' schools and colleges Particulars can be obtained from the director of the Association, Miss C Haslett, 26 George Street, Hanover Square, W 1

WE have received a copy of the first issue of a new Italian monthly review entitled *Leonardo*, devoted to Italian culture in all its varied aspects, and published in Rome under the auspices of the Leonardo Trust and the editorship of Giuseppe Prezzolini The review is illustrated, and is to be conducted apart from political influence and from the influence either of any literary or philosophical school, or of any firm of publishers Its aims are not merely bibliographical, but comprise the study of cultural activities of all forms scholastic, journalistic, theatrical, and even cinematographical This first number contains, among other contributions, articles on the second International Book Fair, to be opened in Florence at the end of April, on the work of several Italian authors, and on British literature relating to Italian matters, together with a number of reviews of Italian books dealing with art, philosophy, hygiene, the literature of Italy and other countries, linguistics, medicine, pedagogy, geography, religion, social and political sciences, history, and the theatre It is well produced, and should command a wide circulation, both in Italy and elsewhere

THE Cambridge University Press announces for early publication vol 1 of a new edition of "Principia Mathematica," by Prof A N Whitehead and the Hon Bertrand Russell There will be three volumes in all

AN interesting catalogue (No 467) of some 1300 second-hand books on anthropology, folk-lore, archæology, and sociology has just been issued by Mr F Edwards, 83 High Street, Marylebone, W 1. Copies can be obtained upon application

WE learn that Messrs J W Atha and Co, who are the distributors for Messrs Carl Zeiss, Jena, have now transferred their business to larger and better equipped premises at Winsley House, Wells Street, Oxford Street, London, W 1

THE Schlomann-Oldenbourg Illustrated Technical Dictionaries in English, French, German, Italian, Russian, and Spanish, are familiar works A British office has now been opened with Mr H I Lewenz as editor and manager, and he will be responsible for the English terms and phrases contained in the dictionaries Volumes are to be issued shortly on weaving and woven materials, on mining, agricultural machinery, chemistry, gas engineering, etc The work is issued and stocked by Messrs Lewenz and Wilkinson, Ltd, 25 Victoria Street, Westminster, S W 1.

Research Items.

FURTHER EXCAVATIONS AT SOLUTRÉ.—*La Nature*, February 14, contains an illustrated report of the excavations at the prehistoric station of Crot-du-Charnier, Solutré, in 1924, which was presented to the Paris Academy of Sciences by MM. Depéret, Arcelin and Mayet on December 15 last. The trench in which three skeletons were found in 1923 was carried farther to the west and revealed the continuation of the thick, undisturbed bed of horse-bone magma. Immediately beneath this was found a fourth skeleton, a male, of Aurignacian age, as was revealed by the associated implements—gravers, flakes, scrapers, etc. Three stone slabs were placed on a level with the head. The legs of this skeleton had been destroyed by the excavations of the Abbé Ducrost in 1875. A fifth skeleton was that of a young woman which lay, not beneath, but actually in the horse-bone bed, which showed no sign of disturbance. The skeleton had clearly been buried there during the period of formation of the bone-bed, which is nothing but the kitchen refuse heap of the Aurignacian hunters, who fed on the horse. This skeleton had no sepulchral slab. A detailed description of the skeletons by Dr. Mayet is in course of preparation. A preliminary report shows that the fourth skeleton is a male of about 40 years of age, in height 1.67 m. to 1.70 m., dolichocephalic, but with a tendency to brachycephaly—index 77.89. The cranium is relatively high, the face broad but low, with prominent cheek bones, orbits quadrangular, low and elongated with an index of 69·7. The fifth skeleton is a female of about 30 years, in height the same as skeleton No. 1—1·53 m. to 1·55 m.—cephalic index 83.24, face broad and very low, orbits oblique, oval and mesoseme—index 86.5. In general it shows a striking resemblance to the female skeleton No. 1 found in 1923. The suggestion that the women belong to a different ethnic group is plausible, although it is recognised that in many ethnic groups the men are big and the women small.

BRONZE IN CHINA.—M. A. Vayson de Pradenne, in collaboration with M. G. Chesneau, Director of the École Nationale Supérieure des Mines, has published in *L'Anthropologie*, T. 34, 6, a metallurgical and archæological study of bronze weapons from China, with special reference to two swords and a halberd which are tentatively assigned to the end of the Bronze Age. The interest of the three weapons in question lies in the fact that not only are they in an excellent state of preservation, but also that they had been tinned. The tinning had taken place after the smoothing and polishing process which followed the casting. An analysis of the bronze shows tin 16.44, copper 82.32, lead 0.15, iron 0.43, zinc 0.20, and of manganese, nickel, and arsenic, traces only. The superficial area shows tin only, with traces of copper at the point of contact with the bronze. The bronze is therefore of a composition which gives the maximum hardness without being brittle, the limit for a weapon which was to receive blows without risk of fracture being put at 16-17 per cent. of tin. It is suggested that the tinning was a device to obtain greater hardness without increasing the brittleness of the weapon. The superposition of tin on the bronze has produced a thin hard layer which offers greater resistance than the inner metal to a steel drill. It is clear that the weapons have been ground and polished after tinning so that the layer of harder metal forms the cutting edge.

CLIMATE AND PLANT DISTRIBUTION IN THE LIGHT OF THE FOSSIL RECORD.—In the Masters Lectures published in the Journal of the Royal Horticultural Society, vol. 50, part 1, January 1925, Prof. A. C. Seward gives a delightful account of Arctic vegetation as studied by him in his Greenland visit of 1921. The keynote of his lectures is to be found in a vivid passage in the first paragraph, in which he speaks of the experience of collecting a fossil frond of a Gleichenia, similar to the living frond he had seen in a Malayan forest, from the rocks below a flower-sprinkled Greenland heath. Prof. Seward attempts to answer the question whether the fossil record of these Arctic latitudes, as symbolised by this Gleichenia, necessitates the assumption that in preglacial times tropical climatic conditions prevailed in these northern climes. He points out that the wide range of climate and altitude covered to-day by Gleichenia suggests the need for caution in drawing such a conclusion. His analysis of the modern Arctic flora, with its dominant herbaceous perennial type, certainly contrasts strongly with the arboreal character of many fossil remains from these latitudes, but Prof. Seward makes it clear that modern investigation has not yet justified the assumption that structure has been directly and profoundly modified by Arctic conditions. His cautious inference appears to be that the contrast of living and extinct floras of Arctic regions like Greenland justifies the assumption of considerable climatic change such as would accompany the changes in the distribution of land and water, of land elevation and water circulation, that might be expected in vast periods of time, but do not involve the assumption of changes in the position of the earth's axis of a nature that the astronomers are not ready to concede.

DYING-BACK OF ROSE SHOOTS.—In the Journal of the Royal Horticultural Society, vol. 50, part 1, January 1925, W. J. Dowson describes very fully a disease met with on rambler roses in the Society's garden at Wisley. The organism responsible for the dying-back of the rose shoots proved to be an ascomycete with small perithecia and was identified as *Gnomonia Rubi*, Rehm. After culture of the isolated organism, successful inoculation experiments were carried out, and no doubt remains that this organism was responsible for the disease. Other occasional records of this parasite, together with field observation, suggest that whilst the fungus may be widely distributed (on brambles and roses) it is relatively rare and seldom does much damage to roses, in this case probably entering the plants through buds previously killed by frost.

SOME INDIAN EARTHWORMS.—Dr. J. Stephenson (Records Ind. Mus., 26, pp. 317-365, 3 pls., 1924) gives an account of some Indian earthworms and describes two new genera of Ocnerodrilinæ. Only a single endemic species—*Gordiodrilus travancorensis*—of this family has until recently been known in India. Michaelsen described a second—*Curgia narayani*—in 1921, and now Stephenson describes two new genera, Malabaria and Aphanascus, which belong to this family. Malabaria is probably the immediate ancestor of Aphanascus, and the latter very possibly leads on to Curgia. The discovery of these worms strengthens the evidence of a faunistic relationship between India and E. Africa. The author refers to the interest of the occurrence of the two new genera in the same place (South Malabar) and surmises that the origin of the younger genus Aphanascus has taken place here and at no remote period, and yet the morphological differences between the two genera are not inconsiderable. It would appear that large morphological changes—sufficient to give rise to new

genera—" may come about in no great length of time, and that evolution may proceed, at times, with large strides and at a rapid pace" The paper forms an interesting addition to the author's analysis of the phylogeny of Indian Megascolecidæ

THE MEDUSÆ OF THE MEDITERRANEAN AND ADJACENT SEAS—In the reports on the Danish Oceanographical Expeditions, 1908-10, to the Mediterranean and adjacent seas (vol 2, pp 67, 1924) Dr P L Kramp describes the collection of medusæ—Anthomedusæ 8 species, Leptomedusæ 6, Trachymedusæ 11, Narcomedusæ 4, and Scyphomedusæ 6, and gives figures of the species and maps showing the distribution of many of them No new species was secured, but the collections have increased our knowledge of the range of distribution Of the 27 species collected in the Mediterranean, only one was a new record for that sea, but several species hitherto known from but a few localities have been found to be widely distributed, and 3 species hitherto known only from the Mediterranean have been found to occur in Cadiz Bay Of the 17 species found by the *Thor* in the Atlantic, between the south coast of Ireland and the north coast of Morocco, seven—chiefly deep-sea forms—do not enter the Mediterranean Dr Kramp discusses in some detail the connexion between the distribution of the species and the hydrographical conditions

PHILIPPINE EARTHQUAKES—The Rev M Saderra Masò, who has studied the Philippine earthquakes for so many years, gives a catalogue of 52 earthquakes of intensities 7 to 10 (Rossi-Forel scale) during the years 1901-22 (Weather Bureau, Manila Central Observatory, for September 1922) Of these, 31 were strong enough to damage buildings Most of them originated under the neighbouring parts of the China Sea, the Celebes Sea, and the Pacific, those taking place beneath land or the inter-island seas being of slighter intensity In all cases, the areas of destruction were those occupied by alluvial deposits As a rule, only poorly-built houses were injured, with one curious exception During an earthquake in 1907, a modern addition to the front of an old building was entirely demolished, while the original portion suffered no injury

STRUCTURE OF A DENDROID GRAPTOLITE—The structure and development of an early form of Dictyonema from the Upper Cambrian of Shropshire has been studied by O M B Bulman (*Geol Mag*, 1925, p 50) The work was facilitated by using a method for separating the fossil from the matrix in which it was embedded It is found that this species of Dictyonema approaches the true graptolites more nearly than do the later forms of the genus, since it shows no true common canal and no spiral arrangement of the hydrothecæ, both of which characters are present in Silurian species This suggests that the dendroid graptolites have been derived from the true graptolites. The hydrothecæ are of two kinds, the smaller (called bithecæ) are budded off from the sides of the larger, and it is suggested that they lodged polyps of the nature of dactylozoids The hollow transverse bars (dissepiments) joining the stipes are formed as outgrowths from the bithecæ

NEPHELINE-SYENITES IN RAJPUTANA—In the Records of the Geological Survey of India (vol 56, part 2, pp 179-197, plates 2-12, 1924) Dr A M Heron gives an account of the nepheline- and sodalite-bearing syenites of Kishengarh in Rajputana These are of unusual interest on account of the occurrence, in some of their pegmatitic forms, of a peculiar sodalite which, when broken, is pale crimson on the freshly-opened surfaces, but rapidly turns to pale grey on exposure to bright daylight The occurrence of this strange phenomenon was noticed first about twenty years ago (Rec Geol Surv Ind, 31, 43, 1904, 32, 158, 1905), but its cause has never been worked out During the visit of the British Association to Canada last year a similar peculiarity was noticed by members of a geological excursion party whilst examining the nepheline-syenite area in the Bancroft area, Ontario, and the change of colour, similarly from crimson to pale grey, is shown in this instance by white translucent sodalite In the Kishengarh area the ordinary deep-blue sodalite occurs, as well as the variety which changes its colour The felspathoid-bearing syenites of this area show considerable variations over a band some ten miles long and two miles broad They occur mainly as sill-like intrusions among the Archæan schists, elongated in the direction of the general strike and often themselves both foliated and banded, but occasionally there are non-foliated pegmatitic forms with individual crystals of nepheline (elæolite) a foot or so in diameter Among the accessory minerals of interest are thulite, cancrinite, and calcite, the last named being regarded as a primary constituent formed direct by consolidation of the magma, as in the case at Sivamalai, in South India, described by Holland in 1901 (Mem Geol Surv Ind, 30, 169-217)

SWEDISH OCEANOGRAPHY—Among the many valuable publications on Swedish meteorology and oceanography is the record made on certain lightships moored off the coasts of Sweden in the Gulf of Bothnia, the Baltic, and the Cattegat The data from ten lightships for 1923 has now appeared (Svenska hydrografisk-biologiska kommissionens Fyrskepp-sundersolening) In some cases the data for the year are incomplete, because ice necessitates the withdrawal of the lightship in winter and early spring The first part of the volumes gives the noon records, including water temperatures at various depths and currents for the days each lightship was functioning. This is followed by salinity records, while the final part has a valuable series of water temperatures at different lightships at various depths in all months of the year for the years 1880 to 1913 This shows some remarkable variations in the Gulf of Bothnia and in the Sound

BENTONITE—The Canadian Department of Mines has recently issued an interesting paper on bentonite (Mines Branch, Pub No 626, by Hugh S Spence, 1924), a peculiar clay-like material concerning which very little information has hitherto been available. Bentonite occurs in Wyoming and other western states of America, and appears to be widespread over the prairie provinces of Canada It is found as a bedded sediment in thin deposits rarely so much as ten feet thick, most of which are of Upper Cretaceous age Its most curious property is its tremendous swelling power when water is added. The volume at the maximum absorption may be five to thirteen times the dry bulk, and the mixture behaves like a true colloid Nevertheless, the deposit is mainly composed of minute flakes of the definite mineral leverrierite, $2Al_2O_3\ 5SiO_2\ 5H_2O$ It also contains a noteworthy amount of adsorbed soda, and a further curious feature is that soda is frequently five times as abundant as potash The origin of bentonite is traced to the hydration of thin water-laid beds of fine vitreous volcanic ash The clay particles appear to have become dispersed as a suspension which afterwards coagulated and settled The peculiar properties of bentonite should ultimately

give it an industrial importance, though at present there is only a small demand, largely on account of the high cost of transport It has already been used as the base of many toilet creams and cosmetics, as a suspending agent in enamel mixtures, in the paper industry, and in the refining of oils and fats The paper gives a long list of other possible applications, and a bibliography of the literature

American Asphalt Industry —Mr. K W Cottrell's report on "Asphalt and Related Bitumens in 1923" (Mineral Resources of the United States, part 2) indicates further progress in this industry, reflected especially in the marketing returns for that year. In the case of natural products the increase amounted to 22 per cent in quantity and 28 per cent in value over the previous year Manufactured asphalt from domestic petroleum, obtained chiefly from refineries in California, Texas, and Illinois, advanced 24 per cent in quantity and 26 per cent in value The total amount of asphalt produced from internal sources during 1923 amounted to 1,395,890 tons, corresponding to a market value of nearly sixteen million dollars To this must be added 1,378,722 tons manufactured from petroleum imported into the United States from Mexico, from which it may be observed that practically 50 per cent of the total output of asphalt in America is of Mexican origin Save for its utilisation in the paper-making industry (see Nature, December 13, 1924, p 873) asphalt has apparently not found any new use during the year under review, the bulk still being employed for paving, roofing, and waterproofing purposes, though the rubber industry's demands have been heavier than in previous years The British Isles is still the largest consumer of asphalt and asphaltic products, Australia, Canada, France, Japan, Spain and Germany following in that order The American asphalt industry now has its own Asphalt Association, a body composed of manufacturers, consumers and technical experts, whose purpose it is to disseminate practical information Co-operation of this kind, always a popular movement in the United States, is a sure sign of growing commercial activity in any industry, and in the present instance the trend of events is indicated by the fact that there are no less than forty independent groups operating in the country which are concerned with the production of asphalt and allied bituminous commodities

The Mercury Vapour Engine —One of the addresses delivered at the centenary of the Franklin Institute in September last dealt with the mercury vapour engine invented by Dr W L R Emmet, of the General Electric Company, and it is printed in the February issue of the Journal of the Institute The mercury is vaporised in a boiler at about 35 lb per square inch pressure and passes to a mercury turbine coupled to a generator giving about 1800 kilowatts The waste heat of the vapour leaving the turbine is utilised in a tube steam boiler giving steam at about 200 lb per sq. in The condensed mercury runs back by gravitation to the mercury boiler The furnace gases from the mercury boiler are used to heat the returning liquid mercury, then to superheat the steam raised in the steam boiler, and lastly to heat the feed water for that boiler The plant has been run for several months at Hartford and has delivered power to the circuits for 800 hours without any troubles of a serious nature arising A plant of 50,000 kilowatt capacity is to be installed at Chicago and a gain of output of 50 or 60 per cent as compared with a modern steam turbine plant of that capacity is expected.

Cold-working of Metals and Hardness —The issue of *Die Naturwissenschaften* of January 2 contains an interesting article by Masing on the cold-working of metals and the resulting hardness produced, considered in the light of the modern work on single metallic crystals of Carpenter, Elam, and Taylor in Great Britain, and Polanyi, Mark, Schmidt, and Czochralski in Germany The knowledge now gained is the result of a detailed study of the deformation of single crystal test pieces under stress which involves an experimental determination of the movement of the crystal axes during the test The work of Taylor and Elam is especially noteworthy in this connexion. In their Bakerian Lecture two years ago they showed that in the distortion of a single crystal test piece of aluminium, the metal was deformed by movement on one octahedral plane up to an extension of 40 per cent After this the crystal axes had moved in such a way that a second octahedral plane came into the conjugate position, and from there onwards the crystal elongated by being pulled out on two planes A point of special interest which emerged from their analysis was that the hardening of the crystal was general and not local, since, when the second plane came into position, the metal was equally resistant to distortion along this plane and that along which it had already been elongated In their recent paper to the Royal Society, Carpenter and Elam showed that the proportional increase in hardening is greatest during the early stages of extension, but that in the case of single crystals a stage is reached when the increase in hardness is approximately proportional to the amount of plastic deformation

Sulphuric Acid Manufacture —The *Chemical Age* for February 7 contains an interesting account of the new Gaillard method of intensive sulphuric acid production Acid is sprayed on to the walls of an air-cooled lead tower from a "turbo-disperser" at the top The impact breaks the drops, which then recoil and form in the body of the tower a heavy acid fog Burner gases are passed up through this fog, which decomposes the nitrosyl sulphate, and condenses the acid already formed The process has been installed at San Carlos, near Malaga, the yields obtained correspond to a chamber space of 1 2 cu ft. per pound of sulphur per 24 hours The process works well with burner gases of both low and high sulphur dioxide content.

Fluctuations of Ash and Nitrogen in Leaves —Jan Wlodek gives some interesting data as to the fluctuations in ash constituents and nitrogen in leaves collected at different hours of the day and night, in the Bulletin de l'Académie Polonaise des Sciences et des Lettres, Séries B, Sciences Naturelles, 1923, pp 65-78 Many ash constituents show important fluctuations from night to day, these being best seen when the results of analysis are expressed as absolute values per biological unit, the leaf In all three species investigated (*Phaseolus vulgaris, Trifolium pratense,* and *Avena sativa*) the sodium oxide content fell during the night, whilst potassium oxide fluctuated very strongly in Phaseolus, less in Trifolium Magnesium oxide remained fairly constant, calcium oxide fluctuated irregularly, silica and SO_3 fell markedly during the night, chlorine remained about constant, P_2O_5 fluctuated irregularly In oats the total nitrogen followed the silica content, in clover it varied irregularly In oats the protein nitrogen on the other hand increased at night, in clover this also varied without regularity These somewhat puzzling results are not discussed in the paper

The Function of the Spleen.

THE number of functions attributed to any organ is often a direct measure of our ignorance as to its real status in the animal economy The spleen has suffered much from a multiplicity of theories as to its functions, but only two appear to be generally accepted, in fœtal life it acts as one of the sources of the cells of the blood, whilst in the adult these cells, especially the red cells, are here broken down and destroyed when they become worn out It appears from recent work by Prof J Barcroft and his collaborators, an account of which is given in the *Lancet* of February 14, that a further extremely important function must be attributed to this organ, in their opinion it acts as a storehouse for the red cells of the blood, a number of which may be kept there ready to be brought back into the circulation at a time of emergency

These workers were first led to a study of this question by finding that when the blood volume increases on exposure of the body to a high external temperature, the increase is not entirely due to the addition of fluid alone to the circulating blood, but that at the same time the total hæmoglobin circulating in the blood increases also There is no evidence of an increase in the number of newly formed red cells until after a few days have elapsed, so that the additional hæmoglobin—and corpuscles containing it—must have come from some store, and not be due to a new formation, at any rate at first, moreover, the rate of appearance of this hæmoglobin is too great for it to be due simply to new formation In their search for this store of red cells the investigators naturally thought of the spleen, if their supposition was to be considered correct, they must be able to answer in the affirmative these two questions: Is there, in fact, a store of red cells in the spleen, which are usually outside the general circulatory stream? Is the number of these stored cells sufficient to account for the increase in circulating hæmoglobin observed on exposure to a high external temperature?

The answer to the first question was found by an examination of the effects of breathing small amounts of carbon monoxide upon the blood in the spleen The experiments were conducted upon a number of different animals, and it was conclusively shown that there was a lag in the taking up of this gas by the red cells in the spleen as compared with those in the general circulation In fact, if the percentage of gas breathed was sufficiently small, the hæmoglobin in the spleen might still contain none after several hours, on the other hand, when the animal was placed again in ordinary air, the carbon monoxide came off from the blood in the spleen much more slowly than from that in the general circulation The blood in the spleen is thus outside the circulation, but this statement is only true for an animal at rest, in activity the carbon monoxide penetrates into the organ at once, so that under these conditions the stored blood appears to be in circulation. Further experiments have shown that under conditions where the amount of oxygen in the blood is less than normal, as, for example, after administration of carbon monoxide, the spleen is stimulated to contract by impulses from the central nervous system, the amount of blood forced out depending partly on the degree of such stimulation Although it has been known for a long time that the spleen can undergo variations in size from the contraction of the unstriped muscle fibres it contains, the reason for this contractility is thus only now becoming apparent Furthermore, bearing this capacity of the spleen to vary its size in mind, it may be asked What is the real size of this organ? And are its variations in size of sufficient amplitude to account for the increase in circulating hæmoglobin with increase in the blood volume?

Little information on these questions can be derived from a study of the size of the spleen in the dead animal, since we have no means of knowing whether the muscle in it has maintained its *in vivo* length We should expect to find, in fact, that it has contracted, so that the organ will be smaller than in life, but how much smaller we cannot judge It is clear that the organ must be examined in the living animal and without subjecting it to any exposure which might stimulate its smooth muscle fibres. Since it is not opaque to the X-rays, Barcroft and his co-workers fastened small metal clips to its edges in the living animal under an anæsthetic After the wound had healed, X-ray photographs were taken in two planes, and from these it was easy to reconstruct in a model the size and shape of the organ under different conditions, the approximate weight was also ascertainable, after the animal had been killed, by comparing its size and weight after death with the size found during life It was found that the weight during life might be two to six times that observed after death, in fact, no less than one-sixth of the total blood volume, or one-third of the red cells, might be contained in the organ during life A comparison of its size at rest and during exercise suggests that an amount of blood equivalent to about one-quarter of the blood volume may be squeezed out of the organ during activity The evidence appears conclusive that a large amount of blood may be stored in the spleen, available for emergencies

Finally, since it is known that in man the spleen may be removed without apparent harm to the individual, Barcroft has inquired whether the absence or not of the organ makes any real difference to the organism He found that animals without spleens died sooner than controls on exposure to an atmosphere containing carbon monoxide Thus an individual with a spleen will be able to meet an emergency with more success than one from whom the organ has been removed

Science in Russia.

IT is gratifying to learn from a correspondent that, throughout the troubled period of the past few years, the splendid premises and wonderful collections of the famous Zoological Museum of the Academy of Sciences in Leningrad have scarcely felt the breath of war, famine, pestilence, and revolution which has passed over them When the English traveller walks in, and is greeted by the famous young mammoth from Siberia, preserved like a recently killed specimen, and sees the rich collections illustrating the fauna of the vast steppes and deserts of Russian Asia, he feels that he is entering into a new world

During the cold winter of 1919–1920, when fuel was unobtainable, it was impossible to heat the Museum premises, but the staff suffered more than the collections Little or no looting was done during the disorders, except that the director had some difficulty in preventing the valuable collection of skins from being taken to be used as furs by the shivering population Far more damage was done

during the severe floods last autumn, when the waters burst into the basement and ground floor, and at least one member of the staff actually saved his own life and that of others by swimming the library was badly damaged, many valuable specimens were ruined by the water and damp, and great inconvenience was caused by the smashing of the stores of alcohol, which is difficult to obtain to-day in Russia, as the supply is under strict Government control and very limited

The entomological collections were enriched in 1914 by the generous gift by A P Semenov-Tian-Shansky of an immense collection of Central Asiatic Coleoptera, consisting of no less than 800,000 specimens the same donor last year presented his own collection of Hymenoptera, Diptera, Neuroptera

The staff of the Zoological Museum consists of ten "senior zoologists," who form a "soviet" and elect their own director, ten "keepers," and eight assistants The present director is A A Bialitsky-Birula, well known from his work upon Arctic zoology, who is also editor of the *Annuaire* Birds are under the charge of P P Sushkin, Member of the Academy, who is well known in Great Britain and the United States Another name well known outside his own country is that of the entomologist A P. Semenov-Tian-Shansky, whose many friends will regret the sad news of his failing eyesight Fortunately, his general health leaves nothing to be desired, and it is to be hoped that he will be spared with capacity for useful work for many years His father, P P Semenov, was a distinguished explorer, who surveyed the Tian Shan mountains, receiving the authority of the Tsar to add the title Tian-Shansky to his surname Other well-known members of the staff are N J Kuznetsov the lepidopterist, G G Jacobson the coleopterist, A K Mordviko the aphidologist, P I Schmidt the ichthyologist, A N. Kirichenko and A M Diakonov, entomologists

The staff of the Museum are, of course, State officials, and paid at least a living wage the salary of a senior zoologist is 47 gold roubles a month, equivalent to about 5*l* this, of course, leaves no margin for luxuries, but they are at least happy in their devotion to science Their chief complaint has been the shortage of modern foreign literature, but this is now to a certain extent being made good There is, however, considerable leeway to make up, and as the postal arrangements are now working satisfactorily, zoologists in England will be doing good work if they bear this in mind

During recent years it has not been possible to publish the results of research work in agriculture in Russia, since the scanty funds for agricultural publications have been used, in the first place, for publishing popular handbooks and pamphlets At the same time, research work has been carried on, often under most unfavourable conditions, and a considerable amount of new facts is awaiting publication The new journal (*Journal fur landwirtschaftliche Wissenschaft*, vol 1 Nos 1-6, Moscow, 1924 (in Russian)), edited by a group of leading professors and research workers of the Moscow Agricultural Academy, aims at becoming a medium for publishing results of research work in all branches of agricultural science The five numbers (one double) before us now include a great variety of papers on different subjects

One of the most interesting papers is by A G Dojarenko, on the utilisation of solar energy by plants (No 1, pp 7-21), which describes the methods used in the author's experimental work for exact measurements of solar energy both received and utilised by cultivated plants, and gives interesting, though only preliminary, conclusions Of considerable general interest is a paper by A. R Minenkov (No 1, pp 29-47) dealing with the problem of chemical determination of sex in plants and in animals, the results of his experimental work are that both in plants and in animals there is a definite sexual difference in the fermenting properties of extract (plants) or blood (animals) which enables one to determine the sex A. D. Prianishnikov (No 3, pp 179-190) describes experiments on the transformation of nitrogen compounds in plants and in animals, the author's conclusion being that the analogies in this respect are very far-reaching and suggest a close similarity of processes in plants and in animals In a paper by V Israilsky and E W Runov the question of the action of vitamins on bacteria is discussed and experiments described, which tend to show that bacteria are very sensitive to vitamins. G D Karpetchenko (No 5-6, pp 390-410) describes hybrids between two plants of different genera, *Raphanus sativus* L and *Brassica oleracea* L, an exhaustive study of the morphology and cytology of hybrids is given These are only a few of the more interesting papers from the journal, which represents, on the whole, an important step in the development of agricultural science in Russia The value of the journal to Russian agricultural research workers is greatly enhanced by abstracts of current literature

University and Educational Intelligence.

Birmingham —The Council of the University at its meeting on March 4 decided to go forward with its purpose for erecting further buildings at Edgbaston to accommodate the three biological departments, botany, zoology, and brewing, with the fermentation industries The approximate estimate of expenditure is 90,000*l*-100,000*l*, and the scheme is only rendered possible by a very generous donation from Mr W Waters Butler of 35,000*l* Another donation to the fund of 5000*l*, given anonymously, was also reported The Biological Departments are at present quite inadequately housed in Edmund Street, and the release of the space in the Edmund Street buildings will enable rearrangements to be made there to facilitate the work of the Faculties of Arts and Medicine, and the new Department of Law When the University was founded in 1900, an imposing scheme for the site at Edgbaston was planned by Sir Aston Webb Substantial progress had been made when the present buildings were opened by King Edward in 1909 The War and its economic consequences, however, prevented further progress The new biological block is a resumption, long delayed, of the original plans

Cambridge —It is proposed to confer Honorary Degrees upon Prof John Joly, professor of geology and mineralogy in the University of Dublin, and on Mr A P Maudslay

The Board of Archæological and Anthropological Studies is recommending certain changes in the regulations for the diploma in anthropology One change would throw open the diploma to any officer of one of the public services of the Empire, not ordinarily resident in the British Isles, who has resided and received instruction in anthropology in Cambridge during three terms or, in the case of an officer possessed of exceptional qualifications, during one term only

Leeds —The degree of Doctor of Science has been awarded to Mr H Hunter for his thesis on "The Improvement of the Barley Crop", and the degree

of Doctor of Medicine to Mr C G K Sharp for his thesis on "Bilharzia Disease" Dr Sharp is the Chief Medical Inspector of Schools, Pietermaritzburg

LONDON —A course of three free public lectures on "The Cretaceous Vegetation of Greenland" will be delivered at University College on March 17, 20 and 24, at 5 30, by Prof A C Seward No tickets will be required

MANCHESTER —The Council has appointed Dr F Craven Moore, lecturer in systematic medicine, to the chair of systematic medicine in the University Dr Craven Moore is the author of numerous papers, chiefly in connexion with diseases of the alimentary canal and metabolic medicine, among which may be mentioned "Cholesterin" and "Diseases of the Stomach" (Practical Encyclopedia, Medical Treatment, 1915), "Compensatory and Regenerative changes in the Liver," *British Medical Journal*, 1908, and "The Rôle of Fats in Treatment of Disorders of Stomach" (with Dr Ferguson), *Lancet*, 1909

OXFORD —The first annual report of the committee for the Lewis Evans collection of scientific instruments has just been issued by Mr R T Gunther, fellow of Magdalen College, the Curator The collection, which has now been appropriately housed in the Old Ashmolean Building, has received several important accessions in the course of the year Interesting exhibits have also been deposited on loan by various colleges and by private collectors, and good progress has been made in the arrangement and labelling of the collection That it has been possible to issue so favourable a report of progress in the proper display of this valuable collection is mainly due to the zeal and energy of Mr Gunther The collection is to be officially opened on May 5, when the Earl of Crawford and Balcarres will deliver an address

An examination for the Theodore Williams medical scholarship at Pembroke College, Oxford, will begin on June 9 The scholarship is of the annual value of 100*l* and is tenable for either four or five years Further particulars may be had from the senior tutor of the college

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DR. OTTO FISCHER, professor of chemistry at the University of Erlangen, who is retiring shortly, will be succeeded by Prof Rudolph Pummerer of Griefswald

DR ADOLPH HEILMANN, chief engineer of the municipal waterworks at Dresden, has been nominated to a professorship at the Technische Hochschule in Dresden

DR WALTER GOSSNER, professor of mineralogy at the University of Tubingen, has been invited to occupy the chair of mineralogy and crystallography at the University of Munich

APPLICATIONS are invited for the chair of agriculture in Auckland University College, New Zealand Particulars are to be had from the High Commissioner for New Zealand, 415 Strand, W C 2 The completed forms must be returned by, at latest, March 31

APPLICATIONS for not more than two Ramsay Memorial Fellowships for Chemical Research (one limited to candidates educated in Glasgow) are invited The annual value of each fellowship is 250*l*, to which not more than 50*l* for expenses may be added The fellowships are normally tenable for two years with a possible extension for a further year Applications must reach the Secretary of the Ramsay Memorial Fellowship Trust, University College, Gower Street, W C 1, by June 6 at latest

THE SCHOOLS RADIO SOCIETY, a section of the Radio Society of Great Britain, is arranging a Schools Radio Exhibition to be held at the L C C Beaufoy Technical Institute, Princes Rd, Vauxhall Street, S E., on March 14-18 Approximately 40 schools are exhibiting, consisting of members of the Schools Radio Society, L C C Schools, and Technical Institutes Apparatus made by scholars and sets used in schools will be shown together with schemes of school wireless work, and there will be a special display and demonstration by the British Broadcasting Company of what they consider to be the ideal set for broadcast reception Admission to the exhibition is by purchase of a programme or by invitation to be obtained from the Secretary, Schools Radio Society, St Paul's School, Dorking

AT the meeting of the Association of Technical Institutions on March 6 and 7, Mr G Mavor, head of the Department of Continuative Education at Loughborough College, in a paper on the conditions of training and education of apprentices, stated that the response to the appeal for information on the subject sent out to the leading firms in a great number of trades had been unsatisfactory as only about 10 per cent had replied From the replies received, it is, however, evident that while there may be a feeling in favour of apprenticeship, neither the trade unions nor the employers appear to be willing to enforce it. Where it exists, it is generally of the unindentured form, for 5 years, and not of an all-round type In some cases the local technical schools are asked to provide evening classes, but in the works the training is generally restricted to one branch, with the possibility of unemployment if the demands on that branch decrease To effect reform, Mr Mavor advocates the raising of the school leaving age to 16 and the provision of part daytime education for all employees up to the age of 18 Some firms have already adopted the latter, and others encourage their employees to attend evening classes, but State action is necessary if the requisite number of "warrant officers" for future industrial progress is to be produced

TEACHERS in technical and evening schools are being offered some very attractive short courses of instruction to be held next summer under arrangements made by the Board of Education at Birmingham, London, Oxford, Cambridge, and Harrogate The University of Birmingham is co-operating with the Board in the provision of courses in engineering science and electrical engineering at Birmingham and Oxford and in mining engineering at Birmingham Prof Burstall, Dean of the Faculty of Science, Profs Batho, Cramp, Lea, Moss, J S Haldane, MacGregor Morris, J S. Townsend, and other members of the University will deliver lectures and conduct demonstrations, tutorial classes, and discussions on teaching methods, and there are to be evening lectures by other eminent authorities in science and engineering The power house of the University as well as its departmental laboratories will be at the disposal of the instructors, and the University halls of residence will be used for the accommodation of those attending the courses At Oxford teachers attending the courses will be lodged in Oriel College At Cambridge a course in commercial subjects will be conducted at one of the colleges The courses in London will include building and surveying subjects and textile subjects The Board is to bear the cost of travelling to and from the places of instruction and to contribute a pound a week towards the cost of maintenance. Applications to attend must be sent to the Board before March 21

Early Science at Oxford.

March 16, 1685–6 Dr Garden of Aberdeen communicated his observations on the weather at Aberdeen in October, November and December 1685 Dr Plot read a discourse concerning ye old Almanacks lately communicated by him, this will be printed in ye Doctor's History of Staffordshire

Mr. Thomas Wickam communicated the case of a Colt foaled with one of ye feet turned, ye heel standing forward, and ye toe backward, which being broken was set right, and grew together again so well, that ye Colt proved as serviceable a horse, as any of his condition thereabout

March 17, 1684–5 —With a letter from Mr Aston came ye Minutes of ye Dublin Society from December 1 to Feb 23, 1684–5 inclusive Orders were given, that the thankes of our Society be returned for these Minutes, and that copies of Sir William Petty's *Supellex Philosophica*, and of Mr Brownlow's answers to ye Queries sent him concerning Lough-Neagh, be desired

A draught of Mr Beaumont's designe for writing ye History of ye Nature and Arts of the County of Somersett, was communicated

Dr Plot presented a Catalogue of some of ye most considerable Arcana and Desiderata in Chymistry as, followes —To reduce any of ye Metalls into a reall fluid To turne ye whole body of mercury into a clear Diaphanous water wetting ye hands To transmute one Metalline Species into another, especially ye baser, into gold and silver, either by projection, Cementation, Commixtion, or Digestion To make the liquor Alkahest, which will dissolve all bodies whatever, except its Compar, and what it is To Sublime Antimony in it's own forme, black and striated To make a Menstruum, not corrosive, that shall perfectly dissolve all ye Metalls, particularly Gold and Silver To make urinous volatile Salt, or Spirit, from most Vegetables To make in good Quantity an Urinous Salt, and Spirit out of a Mineral with little cost To Mummiate an Animal entire without opening, or taking out the intestines, or giving to ye flesh any taste, colour, or smell To make glasse malleable To make many fragments of Diamonds, or other precious stones into one

March 18, 1683–4 —It was ordered that there be no election of Members into ye Philosophical Society, unless there be nine Members (at least) present, to make such election, which Article, with 13 others, agreed on March 11th, 1683–4, being entred in ye Journal Book, were subscribed, by Dr John Wallis, Savilian Professor of Geometry, Dr Ralph Bathurst, President of Trinity, Dr Beeston, Warden of New College, Dr Th Smith, Fellow of Magdalen; Dr Robert Plot, Professor of Chymistry, and Keeper of ye Musæum Ashmoleanum, Dr William Gibbons, St Johns, Edward Bernard, Savilian Professor of Astronomy, Jos Pulleyn of Magd Hall, John Caswell of Hart Hall, Th Piggot, of Wadham, S Des-Masters, of Oriel, J Ballard and W Musgrave, of New College, S Welsted, of Merton

We then passed to other Business Mr Ballard informed ye Society, that ye Amianthus, on which his experiments were tried, was brought from Cyprus, by Dr Huntingdon, and communicated to us by Dr Plot

Manganese (a minerall, dug no where in England, but on Mendip-hills and used in ye purifying of glass) was not of itself affected by ye Magnet, but after above three hours calcination, it readily consented to it, as was shewn us by Dr Plot But Irish slate, calcined about four hours, could not be wrought on by ye Magnet, which gave Dr Plot an occasion to draw up a discourse concerning severall Minerall waters, commonly thought to be Vitrioli

Societies and Academies.

LONDON

Royal Society, March 5 —Sir Arthur **Schuster** On the life statistics of fellows of the Royal Society A revision and extension of a statistical inquiry made by Lieut -Gen R Strachey towards the end of last century Its principal results are (1) The average age at election remained fairly constant between the years 1848, when the nominations for election were placed into the hands of the Council, and the end of the century, the average being 44 4 years There has been a decided increase since then, more especially in the last ten years, but some of this may have been due to war conditions (2) The average age of fellows on January 1, 1923, was 60 9 years (3) Their expectation of life is about 6 years greater than that recorded in the tables published in "Whitaker's Almanac" as applying to the entire population of England —G I **Taylor** and Miss C F **Elam** The plastic extension and fracture of aluminium crystals. In the early stages of the tests under direct tension the previous results are confirmed, and the nature of the distortion in the later stages is now proved to be due to slipping on the two crystal planes previously indicated After double slipping has begun, the rate of slip on the original slip-plane is usually greater than that on the new one The geometrical conditions with a shearing-stress parallel to the slip plane are such that the crystal is quite stable while the slip occurs on one plane, but as soon as double slipping occurs, it becomes far less stable, or even unstable Therefore the specimen usually breaks before it has slipped far on the second plane, but never before the double slipping begins —A **Fage** An experimental study of the vibrations in the blades and shaft of an airscrew The sounds emitted were analysed with 4 Tucker hot-wire microphones used in conjunction with a four-valve amplifier The sounds of rotation which arise from the rotation of the source-and-sink system associated with the pressure differences on the blades are composed of a large number of harmonics, having as fundamental a note of frequency equal to the product of the number of blades and the rotational speed The natural frequencies of flexural vibration were measured for four-blade shapes, the variables of design being width and geometrical pitch The measured frequencies of the shaft vibrations agree very closely with the calculated results, except for a discrepancy of 8 per cent obtained on the heaviest airscrew —J H **Vincent** and A L **Beak** Experiments on the effects of resistance in the oscillating circuit of a triode The circuit employed is that previously used by Eccles and Vincent In this the main oscillator consists of a condenser and coil in series, the coil being variably coupled to the grid coil which is in conductive connexion with a point between the condenser and main coil, the opposite point being joined to the negative end of the plate battery, these two points divide the main oscillating circuit into two branches, inductive and capacitive With this apparatus the conditions were studied under which oscillations could be started and maintained, and the changes in frequency of oscillations and the simultaneous changes in the oscillating and mean plate currents, due to altering resistances in the inductive and capacitive branches of the oscillating circuit. The chief results support Eccles's control equation, but disagree with his formula for changes in frequency. G H **Hardy** The lattice points of a circle Proof of the fundamental identity in the problem of the circle by means of a singular integral the kernel of which is a theta-function, with an application to a theorem of J E Littlewood and A Walfisz, published

recently in the Proceedings —H M **Macdonald** The transmission of electric waves around the earth's surface The transmission of wireless signals to great distances and other phenomena associated with wireless telegraphy have been ascribed to the presence of a conducting layer in the upper atmosphere Such a layer, if it were conducting in the ordinary sense, would act as a screen in respect of electrical effects having their origin external to the layer, and electrical disturbances set up in the space between the earth's surface and the conducting layer would subside very slowly It appears natural, therefore, to assume that, if there is reflection from the upper atmosphere, there must also be radiation through it, to allow a steady state to be attained in a comparatively short time The simplest hypothesis consistent with this is that the upper atmosphere differs from the lower atmosphere in respect of the constants involved in the propagation of electrical effects, namely, the specific inductive capacity and the magnetic permeability On this hypothesis the condition that a steady state of electrical oscillation can be set up in the lower atmosphere in a comparatively short time is investigated Taking an ideal case, the condition is that the ratio of specific inductive capacities is approximately equal to the ratio of magnetic permeabilities —R M **Wilmotte** On the field of force near the neutral point produced by two equal coaxial coils with special reference to the Campbell standard of mutual inductance The accuracy of any apparatus depending on the mutual inductance between two coils and another coil situated at the neutral circle formed by the magnetic field of the first two coils depends largely on the variation of the magnetic force near the neutral circle An expression in terms of the magnetic forces produced by a circular current is obtained for the variation of the mutual inductance due to a small displacement from the neutral circle of a single turn of wire acting as the secondary to two co-axial single-layer coils —W R **Dean** On the theory of elastic stability After Hooke's Law has been extended, two methods are available The three conditions for the equilibrium of an elementary volume may be written down, correctly to the second order, by considering the forces acting upon it, or the strain energy may be calculated to the third order, and the equations obtained by variation With a cylindrical shell the energy method is shorter The equations refer in the first instance to the displacements of any point of the shell To reduce them to equations connecting the displacements of points of the middle surface only, the displacements of any point are expanded in series of the distance of this point from the middle surface, and the boundary conditions at the faces are used —R A **Frazer** On the motion of circular cylinders in a viscous fluid The paper is restricted to two-dimensional flow, and deals primarily with the motion of circular cylinders in fluids of great viscosity, inertia terms being neglected The flow due to a stationary cylinder immersed in a uniform infinite river is treated as the limiting case of flow between two concentric boundaries, the stream being uniform over the outer, and stationary over the inner The essential elements for a solution are obtained with arbitrary velocity distributions specified over any two mutually external circular cylinders The stream-function is completed for the case where the cylinders are in steady rotation Another type of motion investigated is where two spinning cylinders are rotated as a "planetary" system about a particular "focus" The cases examined include "planetary" systems, problems of contact, and the combined rotation and translation of a cylinder in proximity to a wall

Geological Society, January 21 —Léon W **Collet** The latest ideas on the formation of the Alpine range In 1905 Prof E Argand determined in the Pennine Alps the existence of six great recumbent folds or nappes On the base of Argand's results, Dr R Staub found in the north-eastern part of the Swiss Alps the same tectonic elements, covered by six higher nappes belonging more to the type of the "thrust-masses" of the North-Western Highlands of Scotland than to the type of the recumbent folds of the Pennine Alps This new series of nappes has been named by Staub the Austrides, for they form the main part of the Austrian Alps Prof L Kober's discovery of a window or horizontal cut, due to erosion, in the nappes of the Austrides, revealing deeper nappes belonging to the Pennine series, shows that the nappes of the Austrides have been thrust over the Pennine nappes in the Austrian Alps, just as in the north-eastern part of Switzerland Co-ordination of the work by Austrian and Swiss geologists was accomplished at the end of last year by Dr Staub Wegener's ideas on the drifting of continental masses are employed to explain the movement of the hinterland towards the foreland of the geosyncline Foreland and hinterland constitute the boundaries of the great Alpine geosyncline together they recall the two jaws of a vice Prof Argand has shown that the nappes of the Austrides belong to the hinterland that is, to Africa or Gondwanaland Therefore the Austrides, with the Préalpes, represent a small part of Africa resting on Europe or Eurasia

February 4 —A **Heard** The petrology of the district between Nevin and Clynnogfawr (Carnarvonshire) Drift obscures most of the valleys, and conceals the greater part of the areas underlain by unaltered shales Most of the sedimentary rocks consist of dark purplish-grey shales of *Didymograptus-bifidusage*, together with their metamorphosed representatives In the north-western part of the area unfossiliferous pale-grey shales containing numerous ashy and fine-grained gritty bands are present A large proportion of the exposed rocks consists of an igneous complex of post-Lower Arenig —pre-Old Red Sandstone age The intrusive rocks present many petrological variations, including numerous different types of granite and quartz-porphyries, granophyres, porphyries of intermediate composition, and basic rocks The "banding" of the constituents of the coarser-grained intrusive masses is peculiar Neither hybridism nor any apparent chilling is exhibited at the junction of adjacent "bands," and the uppermost band invariably consists of the most basic rock

CAMBRIDGE

Philosophical Society, February 2 —L F **Curtiss** A preliminary note on a direct determination of the distribution of intensity in the natural β-ray spectrum of radium-B and radium-C The number of electrons in each small range of velocity in the β-ray spectrum of radium-B and -C is measured by observing the charge communicated to a Faraday cylinder The advantage is that full weight is given to every portion of the spectrum, and errors due to the variation of ionisation with velocity are avoided. Since in this method it was unnecessary to have any covering over the mouth of the Faraday cylinder, it was possible to investigate very low velocities, and an interesting emission was found about 250 $H\rho$ —C D **Ellis** and W A **Wooster** Note on the heating effect of the γ-rays from radium-B and radium-C The chief difficulty in this determination is due to the presence of the α-rays from radium-C, they produced a heating

one hundred times as great as that due to the γ-rays This was overcome by an automatic compensation method The rise in temperature was measured by means of thermocouples and the equivalent amount of heat found by calibration experiments with heating coils The amount of radium-B + C in equilibrium with 1 gram of radium emits 8 1 cal /hour in the form of γ-rays —C D **Ellis** and M **Bowman-Manifold** The interpretation of β-ray absorption curves The approximate exponential absorption curves are due to the initial heterogeneity of the radiation The absorption curve of a continuous spectrum can be explained by the superposition of the linear absorptions of the β-rays contained in each small range of velocities The form of the continuous spectrum is simply related to the second differential coefficient of the absorption curve —D **Stockdale** A thermostat for high temperatures The instrument is designed to control the heating of electrical resistance furnaces The electro-motive force given by a thermocouple, the hot junction of which is placed in the furnace, is balanced against the fall of potential along a wire If the system is not in equilibrium, a galvanometer is deflected, and a boom carried by this galvanometer touches a wheel, an electrical circuit is closed and a relay is actuated in such a way that the current heating the furnace is altered until equilibrium is again established It was fairly easy to maintain any temperature up to 1000° C with a fluctuation of not more than 3° C —W G **Palmer** A method of finding the composition of adsorption films of mixed gases The gas in an adsorption layer between two fine metallic filaments in mechanical contact can be removed, and metallic contact established by applying to the junction an electric stress, the value of which is characteristic of a particular gas and adsorbing material When a bare surface first comes into contact with a mixture of gases, the composition of the initial film formed is directly calculable from the partial pressures and molecular weights of the gases This film will in general change in composition to an equilibrium value The composition of this final film is given by plotting the relation between electric stress required to remove the initial film and the composition of this film —A P **Cary** and E K **Rideal** The spreading of oils and fats on water surfaces —W **Saddler** Triple binary forms, the complete system for a single (1, 1, 1) form with its geometrical interpretation —W **Burnside** On the phrase " equally probable "

DUBLIN

Royal Dublin Society, January 27 —G **Brownlee** The interpretation of certain empirical standards in their application to Irish butter An investigation of a large number of samples of butter, collected from various creameries by the inspectors of the Department of Agriculture and Technical Instruction of the Irish Free State, has shown that, during the months of November, December, and January, the Reichert-Wolny number of Irish butter is usually below the value 24, which is generally taken as the lower limit for pure butter This is in agreement with the results of a previous investigation carried out some years ago The values obtained for the other numbers used for defining the properties of butter also frequently fell outside the limits generally assumed to be applicable to pure butter —E A **Werner** The decomposition of certain amino acids by alkaline hypobromite

ROME

Royal Academy of the Lincei, November 2 —F **Zambonini** and G **Carobbi**: Double sulphates of rare earth and alkali metals I Double sulphates of lanthanum and potassium Systematic study of the ternary systems composed of these two sulphates and water shows the existence of six compounds containing $La_2(SO_4)_3$, K_2SO_4 and H_2O in the molecular proportions, 1 5 2, 1 4 5 2, 1 4 1, 1 3 0, 2 3 8, and 1 1 2 respectively —Ferruccio **Zambonini** and V **Caglioti** Double sulphates of rare earth and alkali metals II Double sulphates of neodymium and potassium In this case the molecular proportions of the components of the double salts are 1 5 2, 1 4 2, 1 4 1, 1 3 2, 2 3 8, and 1 1 2 —V **Ronchi** An interferential method for the direct determination of the constants and aberrations of divergent optical systems The method of combination fringes previously applied to convergent optical systems is simplified by the use of an auto-collimating arrangement as so to require only a single grating —Dino **Bigiavi** Action of nitrous acid on the azophenols With nitrous acid, *p p*′-dihydroxyazophenol yields a dinitroazophenol, and is also partly oxidised to *p*-nitrophenol, the diazo-group undergoing rupture, benzeneazo-α-naphthol also appears to suffer oxidation, whilst other azo-phenols yield diazonium salts, together with products not yet investigated —G **Carobbi** Double nitrates of metals of the cerium group with copper and with cadmium Compounds of the type $2X(NO_3)_3$, $3Ca(NO_3)_2$, $24H_2O$, where X represents Nd, Pr, Sm, and of the type $2X(NO_3)_3$, $3Cd(NO_3)_2$, $24H_2O$, where X represents La, Ce, Nd, are described, by means of the double nitrates formed with copper, lanthanum may be separated from præseodymium —Gustavo **Cumin** Geological data on the Istrian mountain region II Tectonics and morphology —Marcello **Boldrini** Internal and external measurements of certain long bones in man and in woman II Measurement of the intensity of the secondary sexual characters —Cesare **Artom** Numerical disproportion of the sexes in *Gambusia holbrooki* (Grd) analysed as to its manifold causes For most generations of the top-minnow, the numerical relation of the sexes at birth is 1 1, but in one autumnal generation a predominance of females was observed —Boldrino **Boldrini** Biological reactions observed in the blood serum of woman during and after the lacteal decline II Demonstration of an agglutinin of the globules of human milk —Primo **Dorello** Contribution to the knowledge of the biology of the nemasperms in the pulmonated gasteropods —Carlo **Jucci** Bivoltinism and parthenogenesis in silkworms (*Bombyx mori*) —Sergio **Sergi** Myorabdotic cellular groups in the cervical region of the spinal medulla of the chimpanzee

November 16, 1924 —Luigi **Bianchi** A class of pairs of stratifiable rectilinear congruences —G **Bruni** and G R **Levi** Solid solutions between compounds of elements of different valencies The formation of solid solutions of lithium and magnesium fluorides, previously indicated by the results of thermal analysis of the system, is confirmed by X-ray examination The substitution of magnesium fluoride molecules for a corresponding number of double lithium fluoride molecules produces neither an appreciable alteration in the lithium fluoride lattice nor the appearance of new lines in the photograms —F **Zambonini** and V **Caglioti** Double sulphates of the rare earth and alkali metals II Neodymium and potassium sulphates Descriptions are given of the various double sulphates previously found Federico **Sacco** An opened nummulite —J **Pérès** Transformations which maintain the composition —Bruto **Caldonazzo** Differential geometry of surfaces of hydrodynamic interest —Umberto

Crudeli Rhombic systems with uniform rotation in electronic dynamics.—Paolo **Stranco**: Theory of Einstein fields with axial symmetry.—Guido Horn d'Arturo: Flying shadows visible during solar eclipses.—Rita **Brunetti**: Fine structure of the helium line 5876 Å. U.—G. **Carobbi**: Double chromates of rare earth and alkali metals. I. Lanthanum and potassium chromates. Investigation of the isotherm for 25° reveals the existence of double salts containing $La(CrO_4)_3$, K_2CrO_4, and H_2O in the molecular proportions, 1:1:2, 1:3:2, 1:4:2, 1:45:2, and 1:5:2, these corresponding with the proportions found in the double sulphates of the same metals, excepting that, in the latter case, the 1:3-compound is anhydrous, and the 1:4-salt monohydrated.—Roberto **Savelli**: Genetic value of the process of ionolysis of gametes.—Marcello **Boldrini**: Internal and external measurements of certain long bones in man and in woman. III. The volume of the medullary cavity and hematopoiesis in the two sexes.—A. **Clementi**: Adaptation of tadpoles to the chemico-physical conditions of the surrounding medium.—Boldrino **Boldrini**: Biological reactions observed in the blood serum of woman during and after the lacteal decline. III. Demonstration of the existence of proteolytic enzymes capable of hydrolysing the proteins of human milk.—Carlo **Jucci**: Varying proclivity to parthenogenesis in different races of silkworms (*Bombyx mori*) and its probable correlation with the varying tendency to bivoltinism.—Sergio **Sergi**: Myorabdotic cellular groups in the thoracic region and the limits between the thoracic and lumbar regions in the spinal medulla of the chimpanzee.

VIENNA.

Academy of Sciences, January 8.—K. **Umrath**: The conduction of excitation in the leaf of *Mimosa pudica*. The velocity of conduction is discontinuous and is dependent on the nature and strength of the stimulus. The separate stages may be ascribed to separate conducting systems. The velocity is less in the leaflets than in the secondary leaf-stalk, and less in them than in the primary leaf-stalk. The system of greatest velocity is in the chief bundles.—T. **Ciuropajlowicz**: Two proofs of Fermat's great theorem.—L. **Waldmann**: Report on the geological survey of Moravian territory between Eggenburg, Pernegg, and Theras. A series of orthogneiss intrusions and strata of rocks of sedimentary origin.—G. **Weissenberger**, F. **Schuster**, and K. **Wojnoff**: Molecular compounds of the phenols. VI. The behaviour of hydrated cresols and allied compounds.—L. **Moser** and E. **Reitschl**: The determination and separation of the rare metals from other metals. VI. Determination of the solubility and sensitiveness of complex compounds of cæsium and rubidium and their application in analysis. For quantitative analysis only the chloroplatinate, perchlorate, and bitartrate come into consideration. A quantitative separation was not attained. There is no special cæsium or rubidium reagent, only sensitiveness is decisive. The best indication is given by silico-molybdic acid, by which potassium is not precipitated. Phosphotungstic acid is still more sensitive, but precipitates potassium also.

Official Publications Received.

University of London: University College. Report of the University College Committee (February 1924–February 1925), with Financial Statements (for the Session 1923–24), and other Documents, for Presentation to the Senate. Pp. 101. (London.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1924. Pp. ix+205. (Washington: Government Printing Office.) 65 cents.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 13, Part 3: On the Phenomena of Sex Transition in *Arisaema japonica* Bl. By Tokujiro Maekawa. Pp. 217-305+1 plate. Vol. 15, Part 2: Das Urogenitalsystem der Urodelen. Von Samuro Yamagiwa. Pp. 37-82+4 Tafeln. (Sapporo.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 276: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, in 1921 and 1922. By Daniel L. Hazard. Pp. 100+4 charts. Serial No. 282: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Sitka, Alaska, in 1921 and 1922. By Daniel L. Hazard. Pp. 100+10 charts. (Washington: Government Printing Office.) 25 cents each.

Ceylon Administration Reports for 1923: Department of Agriculture: Report of the Director of Agriculture for 1923. Pp. D54. (Peradeniya.)

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Official Year 1923-24. Pp. 48. (Madras: Government Press.) 6 annas.

Memoirs of the Geological Survey of India. Vol. 48, Part 2: The Geology of parts of the Persian Provinces of Fars, Kirman and Laristan. By Dr. Guy E. Pilgrim. Pp. iv+116+xiii+plates 11-16. (Calcutta: Government of India Central Publication Branch.) 3.12 rupees; 6s. 2d.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indie (The Climate of the Netherlands Indies). Deel 1 (Vol. 1), Algemeene Hoofdstukken (General Chapters), Aflevering 7 (Part 7). With English Summaries. Pp. iv+417-497+199-248. (Batavia.)

Forest Research Institute, Dehra Dun, (U.P.), India: Economic Branch. Testing of Raw Materials. Scheme of Operation No. 1 for Project No. 5, Paper Pulp Section. By W. Raitt. Pp. iii+10. (Calcutta: Government of India Central Publication Branch.) 5 annas; 6d.

Publications of the South African Institute for Medical Research. Edited by Dr. W. Watkins-Pitchford. No. 18: An Investigation into the Significance of Localized and more or less Persistent Râles in the Marginal Areas of the Lungs of apparently Healthy Natives. By Dr. W. Watkins-Pitchford and Dr. Peter Allan. Pp. 35. (Johannesburg.) 5s.

Calendario della Basilica Pontificia del Santissimo Rosario in Valle di Pompei pel 1925. Pp. 256. (Valle di Pompei.)

First Greenwich Catalogue of Stars for 1925.0: Catalogue of 2643 Stars from Observations with the Transit Circle made at the Royal Observatory, Greenwich, during the Years 1915–1921, under the Direction of Sir Frank Watson Dyson. Pp. xix+68. (London: H.M. Stationery Office.) 20s. net.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1922, under the Direction of Sir Frank Dyson. Pp. 8+A57+B4+C2+Dix+D51+E5+Exxi+E84+20. (London: H.M. Stationery Office.) 35s. net.

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1924. Pp. 38+5 maps. (København: G. E. C. Gad.)

The Marine Biological Station at Port Erin (Isle of Man). Supplement to Thirty-eighth Annual Report: List of the Published Works of the late Sir William A. Herdman, C.B.E., F.R.S., D.Sc., etc. Arranged by E. Catherine Herdman. Pp. 25. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 13, No. 3, March. Pp. 531-754. (Plymouth.) 6s. net.

Journal of the Chemical Society: containing Papers communicated to the Society. 1925, Vol. 127, February. Pp. iv+viii+305-498. (London: Gurney and Jackson.)

Journal of the Chemical Society: Supplementary Number, containing Title-pages, Contents and Indexes. 1924, Vol. 125. Pp. 2699-2796+xxx+4. (London: Gurney and Jackson.)

Abstracts of Chemical Papers issued by the Bureau of Chemical Abstracts. A: Pure Chemistry. Supplementary Number, containing Title-pages and Indexes. 1924, Vol. 126. Pp. ii 877-ii 1304+20. (London: Gurney and Jackson.)

Transactions and Proceedings of the Perthshire Society of Natural Science. Vol. 8, Part 1, 1923–24. Pp. 15+xv+5 plates. (Perth.)

U.S. Department of the Interior. Annual Report of the Commissioner of Education to the Secretary of the Interior for the Fiscal Year ended June 30, 1924. Pp. iii+32. (Washington: Government Printing Office.) 5 cents.

Diary of Societies.

SATURDAY, MARCH 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Counting of the Atoms (III.).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at Manchester College of Technology), at 4.—G. Edgington: Oil-Sand Cores.

SUNDAY, MARCH 15.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Criterion Theatre, Piccadilly Circus, W.), at 3.—Dr. H. M. Telling, Dr. M. Thomson, Dr. Jane L. Hawthorne, Dr. Marie Stopes, and others: Why Doctors Disagree about Birth Control.

MONDAY, MARCH 16.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore), at 5.—R. D. Oldham: The Portolan Maps of the Rhône Delta.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Meeting) (at Loughborough College), at 7.—E. R. Caffyn: A Few Features of Early Car Design.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Informal Discussion on The Application of Electricity on Board Ship.

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St Mary's Parsonage, Manchester), at 7 15—J. A Oliver Industrial Electric Vehicles

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30—F G Woollard Some Notes on British Methods of Continuous Production

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8—F R Hiorns The Corporate Spirit in Architecture

ARISTOTELIAN SOCIETY (at University of London Club), at 8—R G Collingwood The Nature and Aims of a Philosophy of History

MEDICAL SOCIETY OF LONDON, at 9—Sir Bernard Spilsbury Wounds and other Injuries (Lettsomian Lectures) (III)

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9 30—Dr H C Cameron John Locke, the Philosopher (1690), on the Upbringing of Children.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court, S W.)

TUESDAY, MARCH 17

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr J A Ryle The Study of Gastric Function in Health and Disease (Goulstonian Lectures) (I)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof E N da C Andrade The Evolution of the Scientific Instrument (II)

ROYAL STATISTICAL SOCIETY (Royal Society of Arts), at 5 15—C W Hurcomb Official Railway Statistics in Great Britain

MINERALOGICAL SOCIETY OF LONDON (at Geological Society), at 5 30—S Tomkeieff The Structure of Aragonite—E D Mountain Potash-oligoclase from Mt Erebus, South Victoria Land, and Anorthoclase from Mt Kenya, E Africa—Dr A Brammall Further Notes on the Association of Lime with other Oxides of RO-type in Minerals

ZOOLOGICAL SOCIETY OF LONDON, at 5 30—Secretary Report on the Additions made to the Society's Menagerie during the month of February 1925—Rev F C R Jourdain A Study on Parasitism in the Cuckoo—C R Narayana Rao and B S Ramanna A New Genus of the Family Engystomatidæ (Batrachia)—Dr Nellie B Eales External Characters, Skin, and Temporal Gland of a Fœtal African Elephant—F F Laidlaw Description of a New Genus and Two New Species of Dragon-flies (Odonata) belonging to the Family Gomphidæ from Tropical Asia.—Rev Dr F J Wyeth The Development and Neuromery of the Mid-Brain and Hind-Brain in *Sphenodon punctatus*

INSTITUTE OF MARINE ENGINEERS, at 6 30—A. C Hardy Motor Passenger Vessels

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Students' Section) (at Leeds University), at 7—W R T Skinner and G E Barrett High-pressure and High-temperature Steam

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers' Club, Manchester), at 7—Col T F Purves The Post Office and Automatic Telephones

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7 15—H T Tizard Address

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 30—(Annual Meeting of Scientific and Technical Group)—Dr T Slater Price Some Modern Views on the Sensitivity of Emulsions

HULL CHEMICAL ENGINEERING SOCIETY (at Grey Street, Hull), at 7 45—N Simkin Some Aspects of Low-Temperature Carbonisation

ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8 30—Annual Meeting.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Wolverhampton)

SOCIETY OF DYERS AND COLOURISTS (Leeds Junior Branch) (Annual Meeting) (at Leeds)—Prof A G Perkin Paper

WEDNESDAY, MARCH 18

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with the Chemical Engineering Group) (at 39 Elmbank Crescent, Glasgow), at 7—Prof J W Hinchley Address

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Sheffield University), at 7 30—G F Jones Some Considerations in the Design, Manufacture, and Testing of Broadcasting Wireless Receiving Apparatus

INSTITUTE OF METALS (North-East Section) (at Armstrong College, Newcastle-upon-Tyne) at 7 30—A. G Lobley Electric Furnaces

ROYAL METEOROLOGICAL SOCIETY, at 7 30—Sir Napier Shaw and H Fahmy The Energy of Saturated Air in a Natural Environment—C K M Douglas The Relation between the Source of the Air and the Upper Air Temperature up to the Base of the Stratosphere—A H R Goldie Waves at an approximately Horizontal Surface of Discontinuity in the Atmosphere

ROYAL SOCIETY OF ARTS, at 8—C N Friese-Greene Colour Cinematography

ENTOMOLOGICAL SOCIETY OF LONDON, at 8

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates' Meeting) (at Chamber of Commerce, Birmingham)

SOCIETY OF GLASS TECHNOLOGY (at Newcastle-upon Tyne)

THURSDAY, MARCH 19

ROYAL SOCIETY, at 4 30—Sir William Hardy and Miss Ida Bircumshaw Boundary Lubrication Plane Surfaces and the Limitations of Amontons' Law (Bakerian Lecture)

LINNEAN SOCIETY OF LONDON, at 5—A S Hirst Parasitic Mites found on Lizards.—W R B Oliver Biogeographical Relations of the New Zealand Region—Mrs M Roach A Study of the Physiology of certain Soil-Algæ in Pure Culture.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr A. J Ryle The Study of Gastric Function in Health and Disease (Goulstonian Lectures) (II)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Dr Leonard Hill The Biological Action of Light (II)

ROYAL AERONAUTICAL SOCIETY, at 5 30—Capt F. Tymms Practical Navigation of Aircraft

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5 30.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6—Comdr B T Coote What the Miners' Welfare Fund is doing for Children and Young People in Mining Communities

INSTITUTION OF ELECTRICAL ENGINEERS, at 6—Presentation of the Faraday Medal to Sir J J Thomson—S Evershed Permanent Magnets in Theory and Practice

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House, Adelphi), at 7 30

INSTITUTE OF CHEMISTRY (Bristol Section) (at Bristol University), at 7 30—Annual Meeting

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Bolbec Hall, Newcastle-upon-Tyne), at 7 30—B J Ives Seaworthiness

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduates' Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30—E A. Harroway British and Foreign Shipyard Practice

CHEMICAL SOCIETY, at 8—D H Bangham and J Stafford The "Activation" of Graphite as a Sorbent of Oxygen

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section, jointly with the Society of Chemical Industry (Edinburgh and East of Scotland Section)) (at North British Station Hotel, Edinburgh), at 8—Informal Meeting

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at Royal Army Medical College, Grosvenor Road, S W), at 8 15—Demonstrations by Drs D Adams, A W Grace, E Hindle and J T Duncan, H B Newham, A S Burgess, Col M Perry, Drs H Seidelin, A C Stevenson, J Gordon Thomson, C M Wenyon, and Mr A. L Sheather, and Prof Warrington Yorke

SOCIETY OF DYERS AND COLOURISTS (West Riding Section)—H P Hird Further Researches on Coal Combustion

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich)—F J Chittenden Experiments with Fruit Trees

FRIDAY, MARCH 20

EUGENICS EDUCATION SOCIETY (at Royal Society), at 5—Dr J Brownlee The Present Tendencies of Population in Great Britain in respect of Quantity and Quality

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Demonstration of Specimens illustrating the Surgical Anatomy of the Middle Ear

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7—F C Tilney Address

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (Annual General Meeting) (at Technical College, Cardiff), at 7 30—G H Clegg Chairman's Address

JUNIOR INSTITUTION OF ENGINEERS, at 7 30—S H Hole Modern Transport

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers), at 7 30—Open Discussion

ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof J W McBain Soaps and the Theory of Colloids

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester)—Dr F. M Rowe, A C Burns, and J S H Davies A New Reaction with certain Diazo Sulphonates derived from β naphthol-1-Sulphonic Acid

SATURDAY, MARCH 21

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ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir Ernest Rutherford The Counting of the Atoms (IV)

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SATURDAY, MARCH 21, 1925

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The Fate of the Energy of the Universe: a Tangled Skein

THE two outstanding conceptions of the nineteenth century were undoubtedly the principle of the conservation of energy, and the closely allied and supplementary principle of the dissipation of energy. Energy was conserved amid all its protean changes, but at each change its availability was lessened. On these two foundations rests the whole structure of thermodynamics. Neither of these conceptions stands exactly where it did, though a good deal of strong evidence will be required to shake the former. In a remarkable paper, read before the Cambridge Philosophical Society only a few months before his death, Prof. Liveing, at the age of ninety-five, threw out a challenge to the latter. Looking back over an active career covering in point of time almost the whole of what we now call science, the veteran felt that the dissipation of energy was not the whole truth. This universe could not be destined to subside into a tideless sea of unavailable energy, moved by no currents, stirred by no ripple, changeless and unchangeable. Somewhere, by some unknown process, the degraded energy must be undergoing a process of renewal and reintegration, to play its part once more in the physical world.

It is interesting to find from the report of a recent address given to the Radio Society by its distinguished president, Sir Oliver Lodge, that similar conclusions have been reached by still another scientific worker of long and ripe experience. In view of his more than youthful energy and freshness of outlook, it would be absurd to call Sir Oliver a veteran, but it cannot be denied that he has had a longer experience of scientific thought than most. His suggestions are always worthy of consideration, and, moreover, are always made in such concrete and positive form as to leave no doubt as to what they are.

Of the earlier parts of Sir Oliver's address it is not necessary to give any account. Towards the end of his discourse, however, after reviewing the principal facts of atomic structure, of photo-electricity, of thermionics, and of radio-telegraphy, he leaves the beaten track of accepted theory and experiment and launches forth on new and dangerous seas of thought. For Sir Oliver Lodge is not content with expressing a belief in the reintegration of energy; he also has a definite theory, or at least the beginnings of a theory, as to how this reintegration is accomplished.

Sir Oliver is at the present time the doughtiest of the champions of the ether, as against the mathematicians of the relativistic school, who, if they do not actually deny its existence, have at least no use for such a medium; and it may be that in times to come this

insistence that a basis for the universe must be sought in a physical medium rather than in a set of equations will be regarded as not the least of his contributions to physics To him the electron and the proton are local modifications of this all-embracing fluid; knots, or, perhaps, bubbles in the ether, a conception already made familiar by Sir Joseph Larmor Thus matter, which is built up of protons and electrons, is just a manifestation of local peculiarities in the ether. The protons and electrons attract each other. "A little friction will disturb and separate them," Sir Oliver reminds us, "but they will get together again as soon as they can. Whenever they approach each other, they radiate The more violent the clash, the more vigorous the radiation Do they ever actually inextricably clash, and annihilate each other? It is not known that they ever do; there seems to be something which keeps them apart Things on earth seem too staid and quiet to allow of an actual destructive clash, or anything like mutual extermination But the operation is conceivable, and as we now know that some of the stars have a temperature to be reckoned in millions of degrees, strange and violent things may be going on there."

"We can," continues Sir Oliver, "at least contemplate the process and ask what would happen if they did; the answer is clear enough The two opposite charges would vanish in a puff of radiation; all that would persist of them would be their energy, there is no destroying that The energy would no longer be localised in specks of matter, it would now wholly and obviously belong to the ether" Sir Oliver thus accepts the transformation of matter into radiant energy, which has been postulated by Jeans and others to account for the intense radiation from the stars; and further suggests that the energy for this colossal output of radiation is supplied by the liberation of the potential energy stored up in the knots or strains in the ether which constitute electrical charges "Dr Jeans tells us that the sun loses 4,000,000 tons of matter every second That is the rate at which it is radiating ether waves—converting matter into ether energy and radiating it away" It may be that Sir Oliver's theory from one point of view adds nothing to Einstein's postulate of the equivalence of matter and energy. It does, however, provide a conceivable picture of the method of transformation, and to the physicist who thinks in pictures rather than in formulæ, this is no small boon

The crux of the address, however, lies in the succeeding paragraph "What I want to ask is," says Sir Oliver, "is there any reciprocity about this process? Matter can turn into radiation Can radiation turn into matter? I surmise that it can, but not under ordinary conditions I guess that the waste radiation careering through space from all the innumerable suns and through innumerable millenniums must have some result I imagine them to be generating matter in the far depths of space, which matter can then by gravitation fall together and reproduce or keep in maintenance the whole material cosmos I see no ultimate dissipation of energy in the universe I see energy passing from matter to ether and back again"

These singular speculations, which we have recorded so far as possible in the author's own words, open up interesting vistas If, as Sir Oliver suggests, these knots possess the property of re-forming themselves when untied, they are indeed ethereal strains wafting to this tangled skein of which we form a part, the promise of an immortality not only in the future but also in the past But, as Sir Oliver himself reminds us, speculation is comparatively useless unless it can be tested, and we are sure that he would not have published this unless he had glimpsed some way in which it might be put to the test of experiment An address to a popular audience did not, perhaps, afford a suitable occasion for the fuller exposition of these matters, which we hope he will shortly give us In the meantime we may be grateful to Sir Oliver Lodge for his challenge to lift our eyes to the wider horizons It is good to be reminded, in this age of scientific progress, how little we really know

Population and Evolution.

Malthus and his Work By Dr James Bonar Second edition. Pp viii+438 (London G Allen and Unwin, Ltd, 1924) *12s 6d* net

"IN October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which everywhere goes on from long continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed"

In these words, Darwin in the well-known autobiographical sketch acknowledged his debt to Malthus. It is also well known that Wallace made a similar acknowledgment In a letter to Prof Newton he referred to the matter as follows

"The most interesting coincidence in the matter, I think, is, that I, as well as Darwin, was led to the theory itself through Malthus—in my case it was his elaborate account of the action of 'preventive checks' in keeping down the population of savage races to a tolerably fixed but scanty number This had strongly impressed me, and it suddenly flashed upon me that all animals are necessarily thus kept down—'the struggle for existence'—while variations, of which I

was always thinking, must necessarily often be beneficial, and would cause those varieties to increase while the injurious variations diminished"

On another occasion, Wallace commented upon the fact that, whereas in his own case it was the recollection of his previous reading of Malthus, which came to him while puzzling over the problems of organic life during an attack of fever when on a visit to the East, Darwin chanced to read Malthus when he had for some time already had the problem of evolution in mind

This difference is of no moment, the profoundly interesting fact is that both the authors of the famous papers read to the Linnean Society on July 1, 1858, afterwards acknowledged their debt to Malthus. It is also an example of the fame of Malthus's book that two specialists in quite another field should have read the book more than forty years after the publication of the first edition. We may guess, however, that they did not pick up the book wholly by chance They probably had some previous idea as to its contents, and were led to study it because they suspected, even if only half consciously, that the theme had some reference to their own studies This turned out to be very much the case. Malthus was not a biologist or a naturalist, though it is perhaps worth noting that his father was an amateur botanist and specifically disposed in his will of a box of plants given to him by Rousseau By training a mathematician (he was ninth wrangler in 1788), Malthus was by taste interested in social problems At Cambridge he was "remarked for talking of what actually exists in nature or may be put to real practical use" rather than for abstract speculations When, therefore, after leaving Cambridge, friendly discussions took place between him and his father, who looked kindly upon Jacobinism, the views of Godwin and prospects of "perfectibility," it is not surprising that the younger man "threw little stones" into his father's garden The son saw practical difficulties in the way of "improving society" and concentrated his attention upon the difficulties connected with population as among the most serious

Malthus was thus led to put his views in the form of an essay, which was much expanded in later editions In the opening chapter, stress is laid upon "the prolific nature of plants or animals," to which there is no bound "but what is made by the crowding and interfering with each other's means of subsistence" Malthus, however, was not interested in plants or animals other than man, and it is with the consequences of man's power of multiplication that he is concerned This hint, nevertheless, was of the utmost value to Darwin "A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase," he says in the famous third chapter of the "Origin of Species" The very phrase "struggle for existence" was, it is interesting to note, used by Malthus himself After some further amplification of the idea of the struggle for existence, Darwin goes on to say that "it is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms"

The influence of Malthus upon Darwin and Wallace is not merely a matter of historical interest. It reminds us of the fact that many social problems are, at the bottom, biological problems There is nowadays a strong revival of interest in the question of population, and we may distinguish between problems connected with the quantity and problems connected with the quality of population Upon both of these problems biologists have much of value to contribute. Indeed, for the solution of many problems of pressing practical importance, further biological research is urgently required. We know little, for example, regarding the comparative fecundity of different races and regarding the influence of variations in the food supply upon the fecundity of members of the same race. There are hints that crowding has an important, though an obscure, influence upon the power of multiplication. Upon these and other important points bearing upon the quantity of population, we await progress in biological inquiry The problems regarding the quality of population, which were formerly much neglected, are now receiving attention and biologists are "throwing little stones" into the gardens of our modern counterparts of the old believers in "perfectibility" They could, however, take far more effective aim if they were furnished with more extensive and accurate data such as further research alone can provide

The widespread interest in population which Malthus aroused gradually died away. To those concerned with social economics it came to seem a remote problem, and biologists had not advanced the study of inheritance far enough to be able to contribute much that was of value Interest has now revived; the War has made certain aspects of pressing importance, and we may be sure that this time the problem has come to stay. Thus a warm welcome is ensured to the new edition of Dr Bonar's well-known book First published in 1885, it has long ago taken its place as a standard work and will now draw a still larger circle of readers As the author says, it is not a treatise on population, but an account of one writer on population, and, we may add, a very illuminating and sympathetic account. There is a certain resemblance between Malthus and Darwin both in character and achievement They were both retiring in disposition, courteous in manner, and capable of inspiring deep affection They both

attained sudden fame by the publication of a single book, they were greatly maligned and, while feeling the attacks made upon them, were recompensed by the knowledge that they had in general gained the assent of the eminent men of their day to their views Lastly, they both sought to avoid controversy and devoted themselves to gathering fresh evidence, leaving their supporters and detractors to fight it out among themselves

Dr Bonar has somewhat expanded the bibliographical section of his book Otherwise it remains as it was, with the addition of certain notes It is a book with which all those who interest themselves in population problems, and among them are nowadays many biologists, will wish to make themselves acquainted

A M C-S

Relativity and Cosmology.

(1) *Einstein's Theory of Relativity* By Prof Max Born Translated by Henry L Brose Pp xi + 293 (London: Methuen and Co, Ltd, 1924) 12s net

(2) *Space and Time. an Experimental Physicist's Conception of these Ideas and of their Alteration* By Prof Carl Benedicks Pp xiv + 98 (London. Methuen and Co, Ltd, 1924) 4s. net

(3) *The Theory of Relativity* By Dr L Silberstein Second edition, enlarged. Pp x + 563. (London Macmillan and Co, Ltd, 1924) 25s net

It is nearly twenty years since Einstein wrote his epoch-making paper on the electrodynamics of moving bodies, in which the fundamental principles of the theory of relativity were first clearly enunciated, and apparently the theory is now approaching the completion of the stage of formal development on one hand and of popular exposition on the other Writers are beginning to turn their attention to work of a more critical character on the roots of the theory —its logical bases and fundamental concepts—and to the detailed investigation of its outlying branches, spreading far into distant regions—the quantum theory, cosmological theories, and so forth The three books under review are typical of this process in some respects, and each is well worthy of the reader's attention

(1) The first book, by Max Born, the successor of W. Voigt in the chair of mathematical physics at the University of Gottingen, and himself well known for researches in the theory of relativity, is considered by some to give the best popular exposition of Einstein's theory in the German language, and for this reason alone an English translation is very welcome It arose out of a course of popular lectures on the subject delivered in the winter of 1919–1920 to an audience without any knowledge of the technique of either mathematics or physics, and, although naturally the treatment has been modified somewhat with a view to publication, the result is an eminently readable account of the subject. No doubt it will in its English guise prove very useful, not only to the general reader and to the popular lecturer, but also to the university student in his first or second year with only a slender equipment of mathematics and physics The treatment in the main follows the historical order of development, but always with special reference to questions of absolute and relative motion and similar changes The first twenty-five pages are devoted to a brief sketch of Newtonian mechanics and Newton's ideas of absolute space and time, the next fifty to the fundamental laws of optics, including optical effects in moving bodies, and about sixty more to the fundamental laws of electrodynamics up to and including the theories of Hertz and of Lorentz, and an account of the Michelson-Morley experiment On this broad foundation the special theory of relativity is expounded in fifty pages, and the general theory in a further forty pages, both mainly on the lines laid down by Einstein The translation is good, misprints are conspicuous by their absence. and the print and style of production excellent

(2) In the second book, Carl Benedicks, the eminent Swedish metallographist, deals with the fundamental principles of space and time measurements from the point of view of the experimenter rather than the logician or mathematician He prefers the traditional views as to the absolute character of space and time and their independence of one another, and considers the reasons put forward by Einstein and his school for changing them to be quite insufficient Without in the least minimising the value of Einstein's explanations of such residual effects as the deflexion of light by the sun and the advance of the perihelion of Mercury's orbit, he does not consider them to be decisive tests of the theory He directs attention to a remark of Poincaré's to the effect that "if one explanation of a phenomenon is found, there are also an infinite number of other ones to be found," and points out that other explanations of both effects have been given already—by Von Soldner a hundred and ten years before Einstein for the deflexion of light, and by G. Bertrand recently for the perihelion effect He inclines to the opinion that an emission theory of light, on the lines of the ideas put forward by W Ritz just before his decease, might be constructed in such a way as to meet these difficulties without necessitating complete changes in the traditional concepts of space and time, for example, on this view an electron is regarded as the "centre of an iterated explosion" Whatever one may think of the author's conclusions, one must admit that this

book of some hundred pages contains much that is interesting and suggestive, and raises several questions well worthy of the attention of relativists, such as the realisation of a true plane by the engineer's method of constructing three mutually fitting face-plates, the synchronisation of two distant clocks by the mechanical device of two wheels connected by an axle free from torsion, etc It can be strongly recommended to any one interested in the logical bases of mechanics and physics

(3) The third book, by L Silberstein, is in many respects the most important of the three, at any rate for the relativist, but no doubt it presupposes a much more extensive mathematical and physical equipment than the other two, it is the second edition, and at the same time an extensive development of the book on the theory of relativity published by the same author in 1914, and reviewed in NATURE of December 10 of that year. That book is reprinted practically without change and forms the first ten chapters of the present work, so that nothing further need be said about this portion, The six added chapters with a number of miscellaneous notes at the end, amounting to about two hundred and sixty pages, or a little less than one-half of the whole, deal with the extensions made in the theory since 1914, mainly in connexion with the general theory of relativity and gravitation, with detailed reference to its cosmological applications The old and new parts of the book together constitute what is perhaps the most complete text-book in the English language on the theory of relativity and gravitation in all its ramifications, certainly the fullest on its cosmological aspects It is worthy of a place beside the standard treatises of Eddington and of Weyl, but not quite as mathematical as the former and perhaps wider in scope than the latter, and written from rather a different point of view than either, so that the three books are in a sense complementary to one another

The author has evidently been at great pains to make the physical meaning of each step in his argument and of every mathematical result as clear as possible, even to a reader not possessed of the very considerable mathematical equipment needed for a thorough understanding of the general theory of relativity. To expect complete success in this respect would, however, be unreasonable, seeing that there are plenty of mathematical processes and results in the theory, about the geometrical and physical meaning of which even experts are not yet fully agreed. We ought to bear in mind what were the conditions respecting the geometrical interpretation of the axioms and concepts of Euclidian geometry before the times of Gauss, Bolyai, and Lobatschewsky, or the physical interpretation of the concepts and laws of Newtonian mechanics before the time of Mach, particularly in view of the great age of these branches of knowledge as compared with the twenty years of relativity

Coming to details we note that the first of the new chapters, the eleventh of the whole book, gives a very readable account, without any formidable array of mathematical symbols, of the logical and historical development which led Einstein from the special to the general theory of relativity. The metrical tensor of the field is introduced, its geometrical and physical implications are considered summarily, and the world geodesics are defined and their physical interpretation is explained The twelfth chapter is purely mathematical, in fifty pages a brief account of the tensor calculus is given, Levi-Civitá's concept of parallelism is explained, and the Riemann-Christoffel tensor is introduced in much the usual way Naturally, the limitations of space imposed by the plan of the book make this chapter difficult for any one not already acquainted with the subject, full references are given to the original authorities, but it might have made it easier for the beginner if reference had also been made to fuller text-books on this particular branch, like those of Galbrun and of Rothe.

The thirteenth chapter deals in some twenty pages with the physical interpretation of geodesics in detail, and is noteworthy in two respects In the first place, it is shown that in the rest system of a freely moving particle the equations of motion of Einstein become identical with the Newtonian equations, not merely approximately, as is generally known, but rigorously Secondly, the treatment of the light paths, or rays, is novel and is utilised to obtain the theory of the experiments reported to have been carried out by Michelson at the Yerkes Observatory with the object of testing Einstein's theory by an absolutely direct method. The fourteenth chapter, of fifty pages, treats of the gravitational field equations and the material energy tensor in much the same manner as in other books, attention being confined, however, to the centrosymmetrical solutions and to Einstein's approximate method. Within these self-imposed limits the author gives an exceptionally complete treatment, including, as he does, an account of de Sitter's geodesic precession and also of Grossmann's critique of the perihelion effect

The fifteenth chapter deals with electromagnetism and gravitation by a little-known method due to Kottler and based upon Minkowski's exposition of the special theory. In about twenty-three pages the author works out the field of a gravitating electric particle, as it were from first principles, a method of treatment which possesses certain advantages from the student's point of view over the usual method based on the principle of least action. The last seven pages of this

chapter contain a very brief sketch of variational methods, of which the author does not appear to be particularly enamoured, but he gives full references to the original authorities with the exception of de Donder, whose "Gravifique Einsteinienne" is not so well known as it deserves The five new chapters so far considered cover the ground usual in text-books on the general theory of relativity, but in some respects the treatment is novel and more complete than usual, as we have pointed out here and there The chief peculiarity of the book, however, lies in the very complete account of the cosmological aspects of the general theory of relativity, which fills nearly one-third of the additional space, about eighty pages.

The author devotes the first thirty pages of the sixteenth and last chapter to a very detailed critical discussion of Einstein's cosmology, based on the assumption of a finite elliptic space filled with matter, uniformly distributed on the average. He explains very clearly how this cosmology leads unavoidably to the existence of singularities of the metrical field—antisuns—at places where there need be no concentration of matter at all, and is therefore untenable, a conclusion in which he agrees with other writers The remaining thirty or more pages of this chapter are devoted to a detailed study of de Sitter's cosmology, to which the author is evidently favourably disposed He discusses de Sitter's spectroscopic distance effect, as well as the more general combined Doppler effect, due both to distance and to radial motion of a celestial object—star, nebula, or cluster—in considerable detail, in the light of Slipher's table of radial velocities of spiral nebulæ and Shapley's tables of the radial velocities of globular clusters Finally, there are fifteen pages of miscellaneous notes dealing mainly with questions relating to world-curvature and cosmology, but also with some recent experimental results regarding the solar spectrum shift, the deflexion of light by the sun, and spectrum shifts of distant celestial objects. Although most relativists would perhaps be loth to lay so much stress as the author does on observations relating to very distant celestial objects, on account of the very speculative character of some of the interpretations put upon them, yet it must be conceded that there is much to be said in favour of the author's view that these observations do lend substantial support, so far as they go, to de Sitter's cosmology, which treats space as finite, elliptic, and generally void of matter, except for the presence here and there of isolated singularities, such as the sun and the stars

This brief survey sufficiently shows that we have before us a book of great interest, which deals with many of the problems arising in the general theory of relativity in a detailed, novel, and up-to-date manner. It may be objected that it is premature to devote so great a proportion of the whole book as one-sixth to so speculative a branch as cosmology, but there is good reason to be thankful to the author for giving us so full an account of this usually neglected portion of the theory For this and many other reasons, Dr Silberstein's book is one which no one interested in the theory of relativity can afford to ignore

The Canadian Arctic.

(1) *With Stefansson in the Arctic* By Harold Noice. Pp 270+16 plates (London, Calcutta and Sydney: G G. Harrap and Co, Ltd., 1924) 7*s* 6*d* net

(2) *The Arctic Forests* By Michael H Mason Pp. xiii + 320 + 53 Plates (London. Hodder and Stoughton, Ltd, 1924) 20*s* net

(1) THE facile pen of Mr Vilhjalmur Stefansson has already made us familiar with the Canadian Arctic islands and his views on the friendliness of Nature in the polar regions, but we may say without prejudice to the leader of the expedition that one needed the opinions and feelings of a rank-and-file member of the party to drive home the theories of the enthusiast. Mr. Noice tells in a frank and pleasant way the events of many months of intimate companionship with his leader, and incidentally unfolds his gradual conversion to the beliefs of Stefansson in a way which carries more conviction than the calm and scientific statements of "The Friendly Arctic" could do There are also many gaps in the earlier narrative which are filled up in this, and new sidelights are thrown on some aspects, as, for example, on the insubordination which so frequently marred the plans and diverted the purpose of the expedition.

To British readers, accustomed now to Antarctic ventures, which of recent years have held the field, the expedition presents many unique features The various headquarters of the expedition were rarely more than 300 miles from the Canadian mainland and not much more from the settlement at Herschel Island In consequence, there were frequent opportunities for refitting from visiting whalers, or of dashing across to find new men or ships, a convenience which proved of doubtful value. Although it enabled the leader to buy or charter no fewer than four ships at various times, it also meant taking with them several men whom he could have done better without The method of employing Eskimo men and women, though not new, was very thoroughly carried out, several women being at an advanced headquarters within 300 miles of the farthest point reached

The most unprecedented feature of the expedition was the reliance for food on what could be found on the

land and under the ice, and the proof positive that for many parts of the region visited there is no need for any one to die of starvation so long as he is able to hunt The abundance of animal and vegetable life is little short of amazing, and the demonstration carried out over some five years, that white men can live and hunt in the Eskimo method, is perhaps the greatest service the expedition has rendered to polar exploration

The claim made in some quarters that this has ended the days of expeditions going out fully equipped from civilisation cannot be said to be substantiated, or at all events must not be accepted without challenge To one who has served on what Mr Stefansson humorously calls a "groceries" expedition, where little thought and the minimum of time was given to the daily food problem, the chief and lasting impression of these two narratives is the amount of time which has to be given up to hunting and cooking, and, one may also add, the number of caribou or ovibos (musk ox) required to support a party of three or four men with dogs That a man of the mental calibre of Mr Stefansson should have to spend day after day hunting for the party may have proved the efficiency of the white man, but at the same time it must have robbed us of a vast amount of skilful scientific observations

It is true that the loss of time spent in hunting was to some extent made up by the rapid methods of travel which the parties used, and their ability to travel in almost any weather The mileage travelled by Noice himself and by others is astonishing, though, owing to unforeseen circumstances, a great deal of it was spent in mere message-taking from one party to another While the loss of two experienced men on one of the journeys warns us that the friendliness of the Arctic is strictly a relative term, there is no doubt that Mr Noice's book supports the earlier one in demonstrating that life in the Canadian Arctic islands can be pleasant and exploration a mere matter of time, provided that Eskimo, and white men trained to Eskimo methods, are taken.

(2) In Mr Mason's book we have the same kind of tale, though in slightly more favoured latitudes The rapid development of the Alaskan territories and the amenities of life there now are little known to us in the Old World, who are apt to look to the tales of hardship in the early days of the "Yukon" for our ideas on the subject The book perhaps attempts too much, in that it ranges from anthropological classifications through true and thrilling stories of camp life to imaginative tales of death and disaster Each section is well written, but cannot claim its full effect when side by side with the others, and indeed conveys the impression of a guide-book compilation, which it is not. But the author most certainly succeeds in his purpose of giving an "accurate general idea" of the country, and will doubtless convert many readers to his firm belief in its future We too are ready to dream of first-class dining-cars running to the shores of the Arctic Ocean during the summer, since the mineral wealth of the country is able to pay for them, but we hesitate to follow so readily the author's claim that it is only a matter of time before cereals will be acclimatised so as to feed the growing population without dependence on outside sources.

F. DEBENHAM.

Applied Chemistry.

The Constituents of Coal Tar By Dr P E Spielmann (Monographs on Industrial Chemistry) Pp xii + 219 (London Longmans, Green and Co, 1924) *12s 6d* net

Aniline and its Derivatives By P. H. Groggins Pp vii + 256 (London · Chapman and Hall, Ltd, 1924) *18s* net

THESE two books present a sharp contrast which is of particular interest at the present time, when many people are concerned to notice in some of our educational institutions a tendency towards early specialisation and the consequent granting of degrees and diplomas to students who have not received, and have not had time to receive, a thorough training in the sciences underlying the branch of applied chemistry they have chosen to adopt For, after all, applied chemistry is applied *chemistry*, that is to say, it is a branch of chemistry, not a science of itself, and a chemist is, or should be, a *chemist* before he elects to follow any of the numerous branches of the parent science which will enable him to adopt an adjectived or hyphenated title It is scarcely possible to insist too strongly on this point because it is difficult adequately to acquire the fundamental principles of a science in later life, and the early neglect of a suitable foundation leads to personal limitations which are difficult to overcome and are apt to hamper the usefulness of the individual not only to himself but also to the community at large.

One of these books is by an English author, the other is by an American The shock is, therefore, not so great when one reads in the preface to the American book that chemistry is a branch of the engineering profession

We in Great Britain are still in the throes of producing a chemical engineer or an engineering chemist fully armed and equipped from out of our universities, and we are not yet all agreed as to how it can best be done in the time available, or as to whether the engineer is to be superimposed on the chemist or the chemist on the engineer Indeed, many of us think that

the term should only be applied to those chemists who have had at least five years' works practice In the United States there appears to be no such problem, and many of the universities in that country have granted degrees in chemical engineering for some time past

(1) In his introduction to the series of monographs on industrial chemistry, Sir Edward Thorpe stated definitely that "they will serve to show how fundamental and essential is the relation of principle to practice," and, now that seventeen volumes of the series have appeared, it is possible to realise how closely this wise provision has been followed It is sometimes urged by reviewers and others that the volumes do not deal with industrial chemistry at all, but are merely compilations of academic interest This is not the case, and the present volume by Dr Spielmann is an instance in point. It was not intended that these volumes should "cover the whole ground of the technology of the matters to which they relate" or be "concerned with the technical minutiæ of manufacture except in so far as these may be necessary to elucidate some point of principle." They are intended for the use of chemists in the real sense of the word, whether academic or industrial, who wish to acquaint themselves with the general practice and most recent development of the branch of applied chemistry under treatment. In these ways Dr. Spielmann's book is a notable addition to the series and will be welcomed by all who desire to follow the most recent advances in coal tar chemistry

The book is well printed and the formulæ are clear, but to any reader who is not an expert organic chemist they may cause trouble, because there appears to be no uniformity of treatment. For example, sometimes the formulæ are written in full as in chrysene (p 103), sometimes in abbreviated form as in naphthacene (p 104) Often the aromatic nuclei are represented as simple rings without adornment (naphthalene, p 72), often the Kekulé double valencies are included (quinaldine, p 159) Sometimes hydrogen atoms are placed at the angles of the benzene hexagon either without the double valencies (coumarone, p 135) or with them (indene, p 73) The effect even on the expert reader is apt to be irritating, and the author might well consider an alteration in this connexion for future editions Had this book been discovered in Tutankhamen's tomb and constituted the sole evidence of the type of graphic formulæ used by the ancient Egyptians, no Rosetta stone would have enabled modern men of science to solve the problem

(2) It is stated in the preface of Mr Groggins' work that this book is intended "for the student of chemical engineering as well as the graduate engineer or works chemist." It is not clear if the "or" in the above sentence implies that the last two terms are synonymous, but, in any case, it is certain that the author intends his book to appeal to a wide circle It constitutes a sharp contrast to Dr Spielmann's book, which is written essentially for the educated chemist and would, in all probability, prove irksome to the usual engineer manager In other words, it is an outcome of the view that the engineer without fundamental chemical training can be supplied with a sufficient working knowledge of the chemistry and physics of a process to enable him to carry through without the aid of a competent chemist The book is, therefore, replete with drawings of plant and the technical minutiæ of aniline manufacture.

It is not the writer's object to quarrel with the method employed, but only to wonder if a book of this kind is really of educational value or whether it is not rather a book of reference. So far as the treatment is concerned it is admirable, and it represents the last word in the technology of aniline manufacture. The chemical theory is a bit scrappy, and if a firm were to rely on the technical information supplied in order to start the manufacture of the base it would, in all probability, have spent all its spare capital long before it had decided on which process to adopt Nevertheless, as a record of the chief processes involved, the book is of real value, and of special importance and utility are the chapters on cost factors (p 91), and on thermal factors (p 104), for these are matters, essential to engineers and chemists alike, to which too little attention is given, the article on the chemist's budget (p 97) is particularly noteworthy and will well repay attention. The chapter on aniline poisoning (p 117) provides some startling facts, and that on general chemical and physical data (p 131) gives information not readily available elsewhere The book is readable and well set up It should be read by all who have an interest in the subject with which it deals

J F T

The Teaching of Physiology and Pathology.

(1) *A Text-book of Physiology* By Prof. H. E. Roaf. Pp viii+605 (London. E Arnold and Co, 1924) 25*s* net

(2) *Text-Book of Pathology* By Prof Robert Muir Pp vii+774 (London· E Arnold and Co, 1924.) 35*s* net

(1) PROF ROAF'S volume is based on the course of instruction given at the London Hospital Medical School, and represents, presumably, a scheme for the presentation of the facts of physiology which he has found to be more satisfactory in its results than the traditional method, for it marks to some extent a new departure in text-books on the subject.

Hitherto it has been usual to consider as a group or system those organs of the body which act together for a common end Thus the physiology of the alimentary system has embraced a description of all those organs the main function of which is to bring about digestion and absorption of an animal's food They have been compared and contrasted as regards their structure, function, and the means whereby their function is regulated in order to further the ends for which they are designed and to assist in the co-ordination of the body as a whole In the work under review this method is not adopted, but, instead, the subject of animal physiology is approached from the point of view of the chief activities which an animal displays Mechanical aspects are dealt with in the first section, chemical activities in the second, regulative mechanics come next and occupy the largest section of the book, and, finally, a special section is devoted to the maintenance of the individual and reproduction

However logical this method may appear in theory, it is not always satisfactory in practice If there is one subject more than another in physiology in which the thermal, chemical, electrical, and mechanical phenomena associated with its action have contributed as a whole to the understanding of its mechanism, it is that of muscle It would seem best, therefore, in dealing with the physiology of muscle, to consider these phenomena in succession in order to show what light each has thrown on the working of a muscle. This, however, has not been done The thermal, mechanical, and electrical changes are described in one section and chemical changes in another, where they are grouped with processes of absorption, excretion, and secretion, with which they have little in common except that in each there is a degradation of energy. Other examples illustrating the difficulties of this scheme of treatment might be given. On the other hand, there is much to be said for a book modelled on these lines, in that it gives the student a new point of view and directs his attention to fundamental likenesses in many aspects of bodily activity which might well escape him in reading text-books written on more familiar lines Were the book a text-book of general physiology, then it could certainly be conceded that the method of treatment adopted by the author is the right one.

Here and there some lack of perspective is shown regarding the space devoted to certain subjects For example, the reaction of sugars with phenyl hydrazine is spread over a page and a half, whereas the depressor nerve and its functions receive only half a page The book is well illustrated and contains some new and useful diagrams

(2) Prof Muir's book is founded on the course in pathology given at the University of Glasgow. The earlier chapters deal with general disturbances of nutrition and of the circulation, the phenomena of inflammation and its sequelæ, and infection, immunity, and fever Then follows a section devoted to the description of tumours and their causation, and finally, the lesions which are met with in the various systems of the body—circulatory, respiratory, alimentary, etc. —are discussed Although there is thus a division of the subject into general and special pathology, it is not apparent in reading the book that any real separation under these two heads occurs That is one of its virtues It is sometimes said that pathology is the study of physiological processes which have "gone wrong," and there is a good deal of truth in this somewhat bald statement What it implies is that many phenomena met with in pathology are really the result of physiological reactions proceeding, it may be, to excess or in an abnormal direction Prof. Muir rightly emphasises this in his introduction, and, what is more, makes practical application of it in his method of teaching Wherever one turns in the book, this underlying idea can be discerned We feel, therefore, that the student who has just completed his course in physiology and has then begun his study of pathology, guided by this book, will find a natural sequence in description, explanation, and discussion which is too seldom met with in books devoted to subjects of the medical curriculum The book thus makes a useful bridge to the gap, which in the past has been too apparent, between the subjects of the second M B examination and those of the later period of the medical student's course

Accounts are given in appropriate places of the investigation of pathological processes by other means than the microscope This instrument has rendered inestimable services in the past and it will no doubt do so in the future, but other methods are available as adjuncts to it, and the experimental investigation of pathological processes is likely to be fruitful in helping to elucidate the initial causes of disease and to explain disturbances of function which result from them The discussion of the results of such methods is not common in text-books of pathology and is therefore to be commended.

The book is admirably proportioned and the illustrations are one of its special features. The author is to be congratulated on them They are all reproductions of photographs which have been made with great technical skill, and it is obvious that they have been carefully selected We feel sure that the book will be widely welcomed by both students of medicine and those engaged in teaching and clinical practice.

H. S R.

Our Bookshelf.

Psychology.

Crime and Insanity By Dr. W. C. Sullivan Pp. vii+259. (London · E. Arnold and Co., 1924.) 12*s*. 6*d* net.

As Medical Superintendent of Broadmoor Asylum, Dr Sullivan is in a position to speak with authority on a subject which is now arousing considerable interest, not only in medical men and jurists, but also among the general public There is no lack of literature dealing with disorders of conduct from the point of view of the alienist, and with criminal responsibility of the insane considered on the standards imposed by the law. The efforts of the author of "Crime and Insanity" have been directed towards presenting the abnormalities of conduct which are dependent on mental disease, as clinical features demanding a study of their nature and origin, and this book is a proof that when approached on these lines, the more special question of criminal responsibility becomes less complex and loses much of the obscurity with which legal subtleties have cloaked it

Responsibility is rightly recognised as being a purely legal question, the law expresses the attitude of the ordinary man of common sense, living at this time and in a particular country. The McNaughten rules, which are always applied as the law of England, though they bear the dignity neither of parliamentary enactment nor judicial decision, enunciate the opinion of the bench of judges in the year 1843 It must be agreed that they do not represent the general feeling of public opinion to-day, and it is widely recognised by lawyers and medical men that they are inadequate; their interpretation by judges is variable and they are rarely applied rigidly. Dr Sullivan points out that the test is unsatisfactory because it is based on a misconception of the facts; he advocates the adoption of a simpler test of responsibility, the admission of qualified responsibility, and the establishment of a system for providing the court with expert evidence concerning the mental state of the accused

Most of this book is devoted to clinical material, and there are numerous descriptions of cases illustrating the criminology of the various types of mental disorder It is an important and practical contribution to the literature of insanity.

VIIth International Congress of Psychology, held at Oxford from July 26 to August 2, 1923, under the Presidency of Charles S Myers Proceedings and Papers, edited by the President Pp xxv+388. (Cambridge. At the University Press, 1924) 12*s* 6*d* net

The various papers collected in this report have a high intrinsic value, but the greatest interest of such a collection is to be obtained by comparing the different points of view rather than by studying the individual contributions The discerning reader can thus obtain a trustworthy insight into the recent progress of psychology, a knowledge of its present position, and even perhaps a prognostication of its future development. The collection is representative of modern psychological thought, containing, as it does, papers from most of the leading British psychologists and from many eminent foreigners The editorial succeeds in emphasising the cordial international relationships which were so evident to all who attended the congress, but it seems unfortunate that no allowance was made for British linguistic ignorance by adding an English summary of the foreign papers

Particularly interesting to the general reader are the various symposiums—"The Nature of General Intelligence and Ability," "The Conception of Nervous and Mental Energy," and "The Principles of Vocational Guidance"—but where there are so many valuable papers it seems invidious to particularise All who wish to be abreast of the times in psychological thought will find this volume a necessary addition to their shelves

Special Talents and Defects: their Significance for Education By Prof Leta S Hollingworth. (Experimental Education Series) Pp xix+216 (New York The Macmillan Co, 1924) 7*s* 6*d* net

Our eyes turn naturally towards the unusual, the one exception to the rule is often more interesting to study than the ninety-nine corroborating cases. There is certainly scientific value in such a study, for a fruitful suggestion is often obtained by comparing the normal with the abnormal to find their common factor.

Prof Hollingworth writes of the exceptional child who shows a particular gift or deficiency in some scholastic subject not to be expected from his general mental level The subject is introduced by a helpful discussion on the nature and causes of abilities and of their inter-relations, and then proceeds to a consideration of the neural base involved The main part of the book is devoted to a detailed presentation of extreme variations of ability in the ordinary school subjects A chapter each is given to reading, spelling, arithmetic, drawing, and music, cases are cited, and causes and remedies are discussed

Every teacher of experience has met children who astonished him by some such unexpected gift or defect This book is valuable for its clear explanations and practical advice in connexion with such phenomena

Natural History.

(1) *Everyday Doings of Insects.* By Evelyn Cheesman Pp 245. (London, Calcutta and Sydney · G G. Harrap and Co., Ltd, 1924) 7*s*. 6*d*

(2) *The Great Little Insect* By Evelyn Cheesman Pp. 256 (London. Hodder and Stoughton, Ltd., 1924) 6*s*. net.

These two books, as may be gathered from their titles, are written essentially for the instruction and entertainment of lay readers Their author, who is curator of insects at the Zoological Gardens at Regent's Park, London, is well qualified to enlighten the public as to many of the facts and theories respective to insect life In her official position she is enabled to judge to a large extent what type of book will meet the demands which she is catering for Both volumes are written in a clear, attractive style and with a "freshness" that comes as the result of a first-hand acquaintance with the objects concerned

(1) The little book entitled "Everyday Doings of Insects" is written with the intention of supplying answers to some of the questions that are often asked concerning the exhibits in the Insect House at the Zoological Gardens It is more especially addressed to boy inquirers with the view of encouraging their interest in entomology The photographs and sketches have been made from the living insect in almost every case, and they add greatly to the attractiveness of the volume

(2) "The Great Little Insect" is intended for older readers, and consists of a series of essays discussing various activities of insects and the laws which we believe govern them In these chapters the author has brought together many facts which, although well known to the entomologist, seldom reach the lay public Such facts are weaved together in an interesting manner, and the volume is a fascinating one for the fireside reading of winter evenings

Illustrations of the British Flora: a Series of Wood Engravings, with Dissections, of British Plants. Drawn by W H Fitch, with additions by W G Smith and others Fifth revised edition Pp xxvii+338 (London: L Reeve and Co, Ltd, 1924) 12*s* net.

THE appearance of the fifth revised edition of the "Illustrations of the British Flora" completes the republication of "Bentham's Handbook of the British Flora." It is universally acknowledged that both the text (now called the Handbook) and the illustrations have been of great use to several generations of botanical students, especially beginners It is, however, unfortunate that the two volumes have been reissued without more drastic alterations having been made A considerable number of serious mistakes are perpetuated, as, for example, in Fig 933, where the leaves of *Populus canescens* are figured as *P alba*, and in Fig. 935, where the catkins of one species and the leaves of another are figured under the name of *P. nigra*

The common vernacular names and, for many species, a letter to indicate the flower colour have been added to the botanical names for each figure A new index has been compiled, giving, in single sequence, the generic and common names A summary of family characters and an analytical key to the families and anomalous genera are reproduced from the Handbook Several new figures are incorporated, but they are not up to the standard set by Fitch

The Teaching of Biology in Schools and Training Colleges By Ethel M Poulton Pp. xv+112 (Birmingham: Cornish Bros, Ltd, 1924) 5*s* net

BIOLOGY, as here considered, is not that of the specialist in zoology or botany, but rather that for which a place is claimed in the general education of all pupils, and especially of those in primary and secondary schools In addition to minor, but not unimportant, objects, the chief aim of such general biology is rightly stated to be the stimulation of interest and curiosity, and to produce enjoyment, both æsthetic and intellectual, of Nature The opening chapters of this useful little book contain an eloquent *apologia* of biology, based upon a consideration of its values and aims, and of the psychological factors which should influence the selection of material and the methods of teaching The teacher who would be ready to give an answer for his faith in biological teaching will find here his brief set out in excellent style. In subsequent chapters the author has constantly in mind the students at training colleges. Though, perhaps, she says nothing that is entirely new on courses of Nature study and the more advanced work, she has nevertheless done good service to all teachers of biology in bringing together, and more or less codifying, the general principles by which all should be guided, and not less in pointing out the many pitfalls that beset the path of the inexperienced. Stress is very properly laid on the importance of presenting biology as a study of *living* things

BACTERIOLOGY

Practical Bacteriology an Introductory Course for Students of Agriculture By Andrew Cunningham. Pp vii+188 (Edinburgh and London Oliver and Boyd, 1924) 7*s* 6*d* net.

A LARGE amount of information is contained in this small book, which is well planned and very readable Bacteriological technique is described in the earlier sections. preparation and sterilisation of culture media, the use of the microscope, and staining methods and cultivation. A series of exercises then follows, each dealing with some particular subject or process, and so arranged that the student becomes familiar by easy stages with bacteriological methods

The bacteriology of milk and dairy products, of soil and manure, is then similarly dealt with, some of the special reactions applied to milk being also included, namely, the catalase, curd, and other tests

In the final chapters some of the more important bacterial plant and animal diseases are described, and classification and formulæ are given in appendices. The practical exercises for the most part are simple and easily carried out in a short time, and have been chosen with commendable discretion; any one who worked through the lessons with some supervision should possess a considerable grip of bacteriology. The book is well produced and illustrated

Elements of Water Bacteriology: with Special Reference to Sanitary Water Analysis By Prof S C Prescott and Prof C. E A Winslow Fourth edition, re-written Pp ix+211 (New York: J. Wiley and Sons, Inc, London: Chapman and Hall, Ltd., 1924) 11*s* 6*d.* net

THE work under notice is, on the whole, an excellent monograph on water bacteriology. First published twenty years ago, the present edition has been revised throughout The procedures outlined are those of the Committee on Standard Methods of the American Public Health Association, and in some respects differ from those current in Great Britain. Chapters on the bacteriology of sewage and sewage effluents and the bacteriological examination of shell-fish are included. Much information has been collected on *Bacillus coli* and its variants and methods for their detection and isolation, though some of the fermentation reactions of the allied organisms are incorrectly given One of the most important chapters is that on the significance and interpretation of bacteriological examinations of water, and the position taken is a thoroughly sound one. A bibliography running into twenty-nine pages completes this useful book.

Louis Pasteur By Prof S J Holmes Pp. vi+246+4 plates (New York: Harcourt, Brace and Co, 1924.) n p.

THIS short biography gives all the essential facts of Pasteur's life and work. Commencing with his early days, the salient features of his researches and discoveries are summarised in chronological order, and for the uninitiated reader explanatory paragraphs are introduced where necessary The text is very readable, and is illustrated with several figures and some good portraits A sympathetic account is given of the celebrations on Pasteur's seventieth birthday and of his last days, and we leave the great veteran sleeping in the beautiful little chapel in the basement of the Pasteur Institute, where "four angels watch over him, Faith, Hope, Charity, and Science, and in the laboratories above his tomb, his great work is going on."

METALLURGY

Practical Microscopical Metallography By Dr R. H Greaves and H Wrighton Pp x+125+28 plates. (London: Chapman and Hall, Ltd., 1924) 16*s* net

THE authors state in their preface that their intention is "to provide, within a small compass, a set of typical photomicrographs suitably annotated and accompanied by an account of such related matters as might profitably occupy the minds of students during the necessarily long hours—many of them spent in purely mechanical operations—devoted to microscopical work," and that the book is intended both for metallurgical students and for students of engineering who study metallography.

We feel some doubt as to whether the book will be found useful. So far as metallurgical students are concerned, it is so restricted in scope that it could not serve as an adequate introduction even to microscopical metallography. None of the chapters deal with the construction of the equilibrium diagram and thermal methods of investigation which, in conjunction with microscopical work, constitute the experimental data on which the diagrams are based. With respect to engineering students, it is necessary to face the fact that the properties of any metal or alloy cannot be deduced from its microstructure The polyhedral structure, characteristic of a pure metal, holds equally for tough and ductile metals on one hand, and for brittle metals on the other Even the most skilled metallographer confronted with a photograph representing the microstructure of a metal or alloy, of the chemical composition of which he was unaware, could say very little about the mechanical properties it would be likely to possess We doubt whether any student of engineering, in the absence of previous knowledge of the subject, could grasp the real implications of the equilibrium diagrams reproduced in the book, and whether he could form a true mental picture of the facts which they convey It seems to us that the book cannot do much more than awaken an interest on the part of metallurgical and engineering students in the subject of microscopical metallography, and a desire to study the subject in a much broader way such as is afforded by one of the numerous text-books of metallography already available.

The Planning, Erection, and Operation of Modern Open-Hearth Steel Works By H Hermanns Pp vii+307 (London. Ernest Benn, Ltd, 1924) 42*s* net.

MR WESLEY AUSTIN has performed a valuable service to English metallurgy in translating Mr Hermann's important work on the planning and operation of modern open-hearth steel works. Technical literature is rich in works which concern themselves with descriptions of the metallurgy of steel production in open hearths. The auxiliaries, however, which serve to carry out the metallurgical work and to lighten or cheapen the mechanical operations, have been given only secondary attention They are of equal economic importance to the processes, and in great measure not only render these possible, but also assure their efficiency The point driven home in this book is the economy which results from excellences in furnace design and equipment, from attention to practical expediencies in the general arrangement of plant, and from a careful lay-out of storage, handling, and transport facilities Every type of equipment for open-hearth steel production is described in detail and very clearly illustrated, not only from Continental practice but also from a very close study of English and American practice The book is intended on one hand for the steel works staff and managers and, on the other hand, for technical and higher grade students In addition, it should provide hints for designers and draftsmen. It is abundantly illustrated by clear drawings, which are one of the best features of the book. We think that Mr Hermann's work would repay careful study by the management of every open-hearth steel works in Great Britain.

Arc Welding Handbook. By C J. Holslag. Pp. xi+250 (London McGraw-Hill Publishing Co, Ltd., 1924) 10*s* net

THIS book is intended to serve as a simple and practical manual of instruction in arc welding An attempt has been made—and made successfully—to describe the methods step by step in a clear and practical manner so that the beginner may understand both the equipment and the processes. The author has also kept in mind those men who may supervise the work, so that there may be no mystery to them about what the welding operator is trying to accomplish The book is very clearly written and illustrated by numerous figures

The early chapters deal with the various types of welds that can be produced Regard is paid both to thin and heavy sections. We have found the chapter on the welding of cast iron and malleable iron particularly interesting There is an illustration on p 125 of a 15-ton cast iron gear housing which had been broken in eight pieces and was afterwards mended by arc welding A total length of 190 feet of welding 1½ inches thick was required Considering the brittleness and low tensile strength of such iron, this must be regarded as a remarkable achievement. Later chapters deal with the welding of structural steel, sheet iron and non-ferrous metals, electric arc cutting, and the welding of alloy steels The book is full of useful information and may be heartily recommended to those for whom it is intended

First (Experimental) Report to the Atmospheric Corrosion Research Committee (of the British Non-Ferrous Metals Research Association) By W. H. J. Vernon. Presented to the Faraday Society, December 17, 1923; with Full Report of Discussion. Pp. 839-934. (London: The Faraday Society, 1924.) 7s. 6d. net.

THE research by Mr. W. H. J. Vernon on the tarnishing and fogging of metals, presented to the Faraday Society on December 17, 1923, of which some account has already appeared in our columns (NATURE, February 2, 1924, p. 178), has now been published with a full report of the discussion which took place on that occasion, together with certain communications since received. The discussion is of a thoroughly broad and representative character, and many points of view and interesting items of information were contributed. Mr. Lancaster mentioned that although it was generally considered that the purest zinc was the most difficult to dissolve in acids, Mr. Rigg, late of the New Jersey Zinc Company, had found that the purest zinc they had produced for the United States Bureau of Standards was almost explosive under acid treatment; in other words, the rate of solution was very rapid. Taken as a whole, the discussion and contributions add decidedly to the value of the report, and general unanimity was expressed that the most hopeful way of solving the practical problem of preventing the tarnishing and fogging of metals was to attack it by laboratory experiments carried out on fundamental lines of scientific inquiry.

ELECTRICAL ENGINEERING

Small Electric Generating Sets Employing Internal Combustion Engines By W. Wilson. Pp. 161+16 plates. (London: Ernest Benn, Ltd., 1924.) 18s. net.

MANY are interested in the small electric generating sets that are used for country-house lighting and for supplying electric power for kinematographs, radiographic outfits, etc., in isolated localities. The invention of the tungsten lamp and recent developments in internal combustion engines have made small installations highly desirable in many cases. Most of the books which deal with this subject are now becoming antiquated, so we welcome Mr. Wilson's volume, which describes the best modern practice.

The author has hit the happy mean between a book overburdened with elementary theoretical matter and one that goes into highly technical details, which are only of interest to the manufacturer. So far as lighting current is concerned, electricity can be generated by the consumer at a cost little more expensive than that charged by a public company. But if it is used for heating and power purposes, it compares very unfavourably with a city supply. For many purposes in connexion with farming, electricity can be economically employed. For illuminating yards, stables, and outbuildings it is most valuable, but it is essential to use suitable water-tight fittings. It has now been conclusively proved that the low productiveness of the hen during the winter months is not due to the want of heat, but to the want of light. The lack of daylight in winter can easily be made up by installing a fifty-watt lamp in the fowl-run. It is required from 5 A.M. until dawn and from dusk until 9 P.M. The switching can easily be done by an automatic device. Under these conditions the hens continue to lay almost as in summer, having the requisite time to take more nourishment.

Alternating Current Rectification: a Mathematical and Practical Treatment from the Engineering View-point. By L. B. W. Jolley. Pp. xviii+352. (London: Chapman and Hall, Ltd., 1924.) 25s. net.

THE conversion of alternating current into current pulsating in one direction is a problem which electrical engineers have been studying for many years. In the early days of the industry, a serious drawback to the use of alternating currents for supply distribution was that there was no accumulator suitable for storing the electrical energy, and hence the alternators had to run night and day. Electrolytic valves were then invented to rectify the alternating current, so that it could be used for charging cells. In polyphase systems of supply, this was accomplished mechanically by machines called rotary converters. At the present moment mercury vapour rectifiers are employed in many towns to get direct current from an alternating supply. In connexion with radio engineering all kinds of rectifiers are used. It will be seen, therefore, that the field is a wide one and it is continually expanding.

Mr. Jolley's book opens with a good discussion of wave form, and Fourier's analysis is applied to several problems in an instructive way. The mechanical rectifiers are next discussed, including a brief description of the Highfield transverter. Then we have descriptions of mercury-vapour rectifiers and vacuum tubes. Interesting descriptions are also given of point to plate discharge, vibrating flame rectifiers, corona rectifiers, and photo-electric cell rectifiers. Finally the author discusses the conduction of electricity through liquids, a knowledge of which is necessary in order to understand electrolytic rectifiers and radio rectifiers. Numerous helpful references are given to papers and books. The book can be recommended to research engineers.

Railway Electrification: a Complete Survey of the Economics of the Different Systems of Railway Electrification from the Engineering and Financial Points of View. By Prof. H. F. Trewman. (The Specialists' Series.) Pp. xii+244. (London: Sir Isaac Pitman and Sons, Ltd., 1924.) 25s. net.

THIS book gives a survey of the economics of the different systems of railway electrification from the engineering point of view. It is pointed out that for the last thirty years electricity has been successfully employed all over the world to operate tramways. At the beginning of the century it was adopted for elevated and tube railways. Then came the electrification of the suburban railways, and finally, mainly on the Continent and in the United States, the electrification of the main line railways. It is universally admitted that electrification of the main line railways in Great Britain is feasible; the only question about which opinions still differ is the financial one. Were it not for the War, at least two British main lines would have been rapidly extending their systems of electrification. Apparently they have adopted a policy of waiting, and so we are continuing to burn an unnecessary quantity

of coal Many who have considered the problem with great care are in favour of electrification This book is written for engineers and contains much valuable data from the point of view of the economics of the problem, but we think that the author could have made out a stronger case for electrification There are not many cases—we know of none—where a railway once electrified has gone back to steam locomotives, but we do know that the electrical staff on most of the English railways is in ludicrous disproportion to the mechanical engineering staff. In Chapter ii the author states that it can be proved mathematically that the best site for a power house from the point of view of transmission costs is the centre of gravity of the load. This theorem has been recently proved to be erroneous. It requires the unwarrantable assumption that the percentage loss of power in the minimum case is the same for all the distributing mains

MISCELLANEOUS.

Animal Nutrition. By Prof T B Wood Pp. viii+226 (London University Tutorial Press, Ltd, 1924) 4s 6d

THE issue of a text-book on animal nutrition from the Cambridge Research Institute marks a new era in the application of science to the feeding of live-stock in Great Britain For so many years have we been in thrall to German and American literature that to be in possession at last of an authoritative work of native origin, however modest its scope and pretensions, induces feelings so pleasurable as largely to disarm criticism We hope that the present modest volume may be regarded as but the forerunner of the more ambitious and comprehensive works that should follow in due course from the Cambridge workers

It is a companion volume to Prof Wood's "Chemistry of Crop Production," these works being admittedly of elementary character, and although designed to meet the needs of the elementary student, bear obvious signs that the possibility of a circulation amongst advanced farmers has not been entirely outside the mind of the writer. This dual aim would seem to have a strong fascination for the agricultural writer —or does the pressure come more from the side of the publisher?—and the result is rarely entirely satisfactory to either class of reader. Few writers possess the genius of Prof. Wood for this class of work, but we venture to think that even he has only attained his end through some sacrifice of the interests of each class of reader Had he been writing solely for the student, who is assumed to have some knowledge of chemistry, he would doubtless have given a rather more advanced treatment of the subject matter of his introductory chapters, whilst a great deal of the detailed experimental work that is embodied in the text might also have been more usefully collected into an appendix or a separate practical manual For the farmer reader, on the other hand, much of this experimental work must necessarily be unintelligible and consequently redundant These criticisms, however, in no way preclude a very favourable opinion upon the treatment of the subject. In his later chapters, in which he turns to practical applications, Prof. Wood is excellent, and this part of his book will be read and used by a far wider circle of readers than that for which it is primarily intended Special reference may be made to his extension to fattening animals of the system of "rationing by performance," which is proving so successful in the case of dairy cows. This is a very real advance, for which all concerned with the difficult task of giving advice on practical feeding problems will be grateful.

The book is well produced and issued at a low price, and may be warmly commended to all agricultural students and others concerned with the feeding of livestock

Clockmaking, Past and Present With which is incorporated the more important portions of "Clocks, Watches and Bells," by the late Lord Grimthorpe, relating to Turret Clocks and Gravity Escapements. By G F C Gordon Pp. viii+232+35 plates (London · Crosby Lockwood and Son, 1925) 16s net.

To the makers and lovers of clocks this volume will be a welcome addition to their bookshelves Though not intended to be a complete treatise on the subject, the author deals systematically with the materials, tools and mechanisms of clock-making and gives much excellent advice. The plates are a notable feature of the book, and though naturally most of them are devoted to various forms of clocks and clock cases, not the least interesting are those illustrating wheel-cutting machines, pinions and their collets, new and old screws, and the clock hands of various periods There is one omission that should be pointed out On p 58, when dealing with compensation balances, it would have been well to explain that the necessity for compensation arises mainly through the change in the elasticity of the spring of the balance due to alteration in temperature, and not through the variation in the dimensions of the balance.

There is a good chapter on the question of restoration and repairs to clocks and clock cases In a short note on British clocks for export, the author offers some criticism of clocks sent abroad, and suggests that if the British Horological Institute were to issue designs and detailed specifications for three or four types of clocks, it would confer a great benefit on all concerned A bibliography is given containing some 80 or 90 books and pamphlets on clocks published since the appearance of Derham's "The Artificial Clockmaker" of 1696

Around the Horn to the Sandwich Islands and California, 1845–1850 Being a Personal Record kept by Prof Chester S. Lyman Edited by Prof. F J Teggart. Pp xviii+328+16 plates (New Haven Yale University Press; London Oxford University Press, 1924) 16s net

PROF C S LYMAN was connected with Yale University for thirty-two years as professor of physics and astronomy and director of the observatory. He died in 1890 at the age of seventy-six. This book is the diary which he kept as a young man during several years in the Sandwich Islands and California. The long sea voyage round Cape Horn occupies only a few pages His observations on the people of the Sandwich Islands are of value as a record of past conditions, and there is a good account of the volcano of Kilauea. Most of the diary has little scientific interest, though some of the descriptive matter is vivid. There are many interesting illustrations taken from old prints.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications.*]

The Exploded Ether.

THE idea of a universal physical æther seems to be getting terribly in the way According to Dr Jeans, in the Supplement to NATURE of March 7, p 362, "It was something more than a coincidence that Newton, Kelvin, Clerk Maxwell, and Faraday [the advocates of an æther] were all British, while Boscovich, Einstein, and Weyl are not" Descartes is not mentioned

One notices that the reason for supplanting Maxwell by Weyl is based on the original form of "Weyl's electromagnetic theory," which aims at absorbing electric fields into space—a theory which Einstein has steadily and consistently rejected, for the reason that its "two-foot rule" changes its length as it wanders through space, so that when it comes back to its starting-place it does not recover its original length, and (metaphorically) you don't know where you are

Seizing on an idea of Eddington's, and utilising the Principle of Minimal Action, which is fundamental in physical formulations, Einstein has himself developed a theory analogous to Weyl's but he has to admit that it cannot in his hands explain electricity by atomic electrons It has, however, been claimed by another investigator that this can be got over by use of a widened foundation, and the question perhaps deserves further scrutiny by experts A quotation is here relevant, from Prof De Donder of Brussels, the most recent exponent of this interesting but very complex algebraic analysis "En lisant les trois notes qu'Einstein a consacrées à la gravifique de Weyl-Eddington, on remarque que la confiance que lui inspire cette théorie va en diminuant C'est ce qui m'a conduit à lui demander son avis actuel, afin de pouvoir le communiquer au cours de mes conférences à la Sorbonne J'extrais de sa lettre (Leiden, 4, xii 1923) la phrase très importante 'Deshalb neige ich jetzt dazu, der ganzen theoretischen Entwickelung, welche auf einer Verallgemeinerung der Riemann'schen Metrik durch Verallgemeinerung der $\Gamma^{\sigma}_{\mu\nu}$ beruht, uberhaupt keine *physikalische* Bedeutung beizumessen'"

If there is a distinctively British view of the æther, it is the one that was promoted, in his usual fragmentary and erratic manner, by Kelvin, the inspirer, along with Faraday, of Clerk Maxwell It identifies the æther as the substratum, with physical qualities, in which all matter subsists as a limited number of possible types of atomic structures, and which, moreover, binds these discrete atoms into a cosmos by their necessary interactions across it Being the medium which makes atomic matter possible, it is not itself matter, and is not limited by any analogy to matter It makes no essential difference whether one visualises it as an active physical medium or alternatively describes it as "space," or a "fourfold extension," endowed with physical qualities. The earlier analogies introduced waves of light and the electric field by contemplating displacement of the small parts of the æther, a varying displacement involving strain with its energy of elastic deformation The newer representations become feasible through introducing the cognate notion of "parallel displacement" of the varying "space," as defined by the algebraic formulations of Prof Levi-Civita. The relevant problem, as above indicated, is to carry the ideas through as far as possible, and so test the extent and appropriateness of their analogy with physical reality

Fundamental space and time ought, one would think, to be uniform, the same everywhere As soon as the qualities of space are made to depend on the presence of adjacent portions of matter, it ceases to be pure space and becomes an interconnecting medium with physical properties But this subject, on its epistemological side, is far from having yet been exhausted JOSEPH LARMOR

Cambridge, March 7

Ether and Matter and Relativity.

IN the most valuable supplement to NATURE of March 7, through his Kelvin lecture to the Institution of Electrical Engineers, Dr Jeans gives a splendid summary of the present position in physics, showing how Lord Kelvin's "two clouds" obscuring the connexion of radiation and matter, instead of dispersing, have expanded to fill our scientific vision. Incidentally, Dr Jeans makes it clear that in his view the terms ether and force are unnecessary, since all that they connote can be represented equally well by pure geometry, and indeed much better than by Lord Kelvin's curiously mechanical mode of attack It is marvellous what hyper-geometry can be made to express, and what high reasoning about reality can be thus carried on But here comes the point I suppose that much the same can be said about the non-necessity of the idea of matter That too can be expressed geometrically, and apparently dealt with analytically, as the impenetrable centre of a warp in space, and as $G^{\nu}_{\mu} - \frac{1}{2}g^{\nu}_{\mu}G$, an expression which Prof Eddington says behaves exactly like matter, except that it is more continuous than atomic, adding that the mind could scarcely recognise anything simpler as substantial and permanent ("Math Theory of Relativity," p 120) If relativists will grant that ether and matter can be *equally* dispensed with, a supporter of the ether need have no conflict with them for ultimate questions about reality and existence can be left to philosophers

OLIVER LODGE

March 10

The Source of Stellar Energy.

THE source of a star's energy is debated in recent letters by Prof Lindemann and Dr Jeans (NATURE, Feb 14 and 28) Dr Jeans's conclusion is that the liberation of energy from the sub-atomic store occurs at a rate independent of temperature and density, and if one star liberates energy more slowly than another, it is solely because the former has exhausted the more prolific material I think that there are grave astronomical objections to this view.

First, it requires that the rate of emission of radiation by the star shall be very largely dependent on its previous history, whereas the astronomical indications are that it is so closely correlated to the present mass that there is little scope for outside factors Consider, for example, two stars, each of which has radiated $\frac{2}{3}$ of its original mass, so that they are in the same stage of exhaustion. the first, originally of mass 3, is now of mass 1, the second, originally of mass 12, is now of mass 4 Their rates of radiation should accordingly be in the ratio 1 4, but both theory and observation seem to show that a star of mass 4 always radiates much more than 4 times as strongly as the sun

Secondly, this hypothesis seems to make the stars unstable The energy E which is liberated must be

got rid of by radiation, and the radiation L is fixed by the mass and (to a comparatively small extent) the radius of the star By hypothesis, E cannot be altered by a change in the physical conditions, so that the star must adjust its radius to bring L to the right amount If initially $E > L$ the star is gaining energy and therefore expanding; the physical theory indicates that an increase of radius diminishes L, so that the discrepancy becomes worse The star expands indefinitely

The first objection is particularly evident when applied to the components of double stars which must contain material of the same age and, therefore, of the same degree of exhaustion The hypothesis requires that these shall emit energy proportionately to their masses—a result which is not verified The particular case of the sun and the earth is referred to by Dr Jeans, who meets the objection with a suggestion that the material forming the earth was not an average sample of the material of the sun at the time of separation A short time ago I would have admitted this possibility, but I have recently found (in an article in the *Observatory* for March) that the rotation of a star must necessarily lead to circulatory currents in the interior which would keep the material well mixed The argument is based on an extraordinarily general formula discovered by H von Zeipel, and I do not think the conclusion can be evaded It follows that when a star divides, each part has the same chemical composition, and if Jeans's rule were true the two parts would continue to be similar through all subsequent time

It is very difficult to find a law of liberation which will satisfy astronomical requirements In abandoning the contraction hypothesis we seem to have jumped out of the frying-pan into the fire—not that I see any conceivable prospect of returning to our former refuge A direct dependence of the rate of liberation on density and temperature seems to be ruled out On calculating the numerical magnitudes concerned (after taking into account all possible exhaustion-effects), it is found to give the star a kind of over-stability which would rapidly magnify the smallest disturbance into a large pulsation This pulsation is supposed to occur in cepheid variables, but these are limited to a well-defined range of mass and density With the hypothesis here considered cepheid variation would be more widespread

At present, I see no insuperable objection to the following hypothesis, I scarcely recommend it in its present form, but some theory on these lines seems to be the one way out of an almost hopeless deadlock We must consider two processes. one of evolution, the other of disappearance, of certain destructible forms of matter The former is supposed to be dependent on density and temperature the latter to be independent It must be understood that the two processes are not the reverse of one another The first is a transmutation absorbing or releasing comparatively little energy, the second is an annihilation of matter releasing great quantities of energy The first is a synthesis involving the bringing together of constituents, its rate therefore depends on physical conditions The second is a spontaneous degeneration in which only an isolated atom is concerned The destructible elements are supposed to have lives ranging from a few minutes to many years, but most of the released energy comes from the long-lived products A quiescent star will be in a steady state, except for the slow alteration of mass, the amount of self-destroying material and consequent generation of heat is thus dependent on temperature and density Pulsation of the star will affect the rate of liberation only through the short-lived products, it should thus be possible to obtain stability without over-stability. It is necessary to admit exhaustion-effects also in this scheme, in order to reconcile, for example, the rapid liberation of energy in Capella with the slow liberation in the sun, notwithstanding the higher temperature and density in the latter

I believe it is widely thought that the comfortable phrase *sub-atomic energy* ought to make the astronomer entirely happy, it gives him a long enough time-scale, and all is plain-sailing Attempts to guess the *modus operandi* are regarded as mere speculation in an unlimited field No doubt it is highly speculative to try to predict the processes by extrapolation of the modern theories of atomic physics, but the approach from the astronomical side is merely the prosaic procedure of empirically deducing unknown laws from observational data Stellar astronomy is largely occupied with determining the rate of liberation of the mysterious source in conditions of temperature and density (both static and disturbed) which are now reasonably well known Either the astronomer must leave this mass of data uncorrelated, or he must try to feel his way towards the disentanglement of the unknown agencies A S Eddington

Observatory, Cambridge,
March 4

The Ages and Masses of the Stars.

Concerning Mr Schumann's comments (Nature, January 24) upon Dr Jeans's paper (December 6) on "The Ages and Masses of the Stars," I should like to direct attention to the point of view expressed in my paper on "The Age of the Stars" which was read before the National Academy of Sciences on November 11 last, a few days before the meeting at which Dr Jeans presented his work to the Royal Astronomical Society It was there emphasised that the decrease of mass as a result of radiation is a necessary consequence of the theory of relativity If relativity be accepted this must be so, independently of the mechanism involved in the change of mass as *matter* into mass as *radiation* The fact that a star radiates means that it loses mass in this way whether all the mass lost is lost by radiation is another matter My paper, which is to appear in the Proceedings of the National Academy of Sciences for February, goes into the point more fully than I can here

Edward Condon

Physics Department, University of California,
February 14

Late Palæolithic Art in the Cresswell Caves.

No one could welcome the results of Messrs Garfitt and Armstrong's exploration of Cresswell Crags more than I do myself, especially as they relieve the Palæolithic inhabitants of these islands from the unmerited reproach of an indifference to art I only wish they had been made in time for recognition in the last edition of "Ancient Hunters"

In the light of these recent discoveries, the problem of the Cresswell "horse" assumes quite a different aspect, and I feel all the more bound to offer an explanation of the statement for which I am responsible, referred to by Sir W Boyd Dawkins in Nature of March 7, p 336 It arose out of a conversation with the Rev A M Mullins, rector of Langwith-Bassett, well known by his exploration of the Langwith Cavern, which is situated within easy reach of Cresswell Crags Happening to refer to the almost complete absence of any artistic work in the Palæolithic deposits of this country, I mentioned

the famous horse as the only known exception to the general rule, when Mr Mullins at once interposed with the remark, "And that is no exception," and proceeded to inform me that it had been introduced surreptitiously into the cave, more than one person—as I understood—having been involved in this nefarious proceeding He demurred, however, and as I thought very naturally, to my request for names, but assured me that he spoke of his own personal knowledge

Any reflexion on the good faith of any of the explorers of the cavern—particularly my old and dear friend the Rev Magens Mello, the actual finder of the engraving—would have at once aroused my indignant resentment, but there was no hint of this, and as Mr Mullins's statement not only disposed finally of what I had always regarded as malicious gossip, but was also in general harmony with the state of knowledge at the time, I felt that I ought to make it public, even if only in a modest footnote

It is to be regretted that Mr Mullins is no longer with us to add his explanations to mine All I can do now is to withdraw the controverted statement and to delete it from the footnote at the earliest opportunity

Perhaps I may be permitted to refer to another discovery which was made too late for notice in my last edition It is of great importance, since it affects not merely a locality but a whole industry I allude to the finding by M Peyrony in a Solutrean layer at Les Eyzies of a slab of limestone bearing a carving in high relief of two oxen (*Bos primigenius*) When I examined this last Christmas I was much impressed by its skilful modelling, fidelity to Nature, and artistic feeling It recalls, though less bold, the famous bisons of Tuc d'Audoubert

Hitherto the Solutrean age has afforded no objects of art, and this has always been regarded as a remarkable fact, for the Solutrean people were the first to introduce that new method in the working of flint which produced the most beautiful weapons of the Palæolithic age, and afterwards found its culmination in the wonderful productions of Neolithic Egypt and recent North America It was supposed in explanation that the Solutreans were a war-like invading race, who concentrated all their attention upon the perfection of their weapons, and had none left to bestow on purely artistic effort We now see how far this was from the truth W J SOLLAS

University College, Oxford,
March 10

Transmission of Stimuli in Plants

MR SNOW's letter on this subject in NATURE of January 17, p 82, suggests the following considerations

The fact that the velocity of the movement of coloured fluids in transpiring shoots and leaves is often much slower than the transmission of stimuli can scarcely be used as an effective argument against the rapid transport of hormones in the transpiration current. When a shoot, or leaf, is cut across and supplied with stain, the whole, or most, of the cross-section of its wood may be utilised by the current, and the velocity of flow may be comparatively slow, whereas, if the water transpired is made good through a conduit consisting of one or two tracheæ only, the velocity may be very great It is significant that Mr. Snow himself attributes the transmission of a stimulus at a velocity of 52 cm per minute to the movement of water in the vessels (Snow, R, Proc R S B, vol 96, p 358)

Mr Snow refers to his Experiment 11 In this experiment the wood of the petiole of a "stem and leaf preparation" was severed by a single cut of a razor The tension of the water in the wood was relieved by the submergence of the preparation in water, and yet, after a rest of several hours, a stimulus was observed to be transmitted across the cut to the pulvinus. It still seems to me possible that the movement of the motile tissue at the base of the pinnules forced water containing the hormone through the distal tracheæ and that some of this was drawn (really pressed by the atmosphere) into the tracheæ below the cut The continued expansion of the cells adjacent to these tracheæ by turgor would give space for this movement Thus relief of the tension might not preclude motion in the tracheæ.

In any case, the experiment requires careful confirmation It appears from Mr Snow's description that the experiment was attempted with 40 stem and leaf preparations The exact depth of cut required, just severing the continuity of the wood, was attained in only 5 of these Of these 5, 3 showed no transmission of the stimulus across the cut The extreme difficulty of ascertaining with certainty, even with microscopic observation, that all the water-conducting elements were cut across, and remained severed during the experiment, may justify us in suspending our judgment as to the correct interpretation of this experiment

Mr. Snow also invites attention to his Experiment 12, in which he observed that exposing a narrow zone of a petiole to steam prevented the passage of a stimulus In his paper he points out that both Haberlandt and Fitting obtained the opposite result Furthermore, it is quite probable that substances introduced into, or developed in, the tracheæ by the heat may have prevented rapid motion of fluids in these capillaries

With some trouble I have succeeded in consulting, at Mr Snow's advice, Prof Herbert's paper in the *Philippine Agriculturist* It has disappointed me The details of the experimental arrangements are scanty throughout, and until more convincing evidence is produced I could scarcely agree with Mr Snow's statement—"The xylem of the petiole cannot conduct excitation downward at all, as has been shown by Herbert" In fact the latter emphasises more than once that, if the downward transmission is to be prevented, "a good deal of the wood" must be removed Further, when "dexylification" was practised by Herbert, he filled the cavity left by the removal of the wood with water. In this, of course, the hormone may have been transmitted, as in Ricca's experiments

Mr Snow quotes Bose as having showed that the phloem is the conducting tissue, by evidence derived from electrical changes Unfortunately the same investigator produces the same evidence in favour of transmission in the parenchyma on the inner side of the xylem, mistaking it for phloem To this tissue both Snow and Herbert deny the power of transmission HENRY H DIXON

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Indian Kala Azar Commission.

IN the issue of NATURE dated December 6, 1924, page 840, under a notice of the anniversary meeting of the Royal Society, mention is made of an investigation to be carried out under the auspices of that Society upon kala azar in India The steady spread of kala azar in India has for long been a most disquieting feature in certain provinces Recently, as a

result of the action of certain Provincial Governments in providing and encouraging treatment in the villages, the number of cases that have come forward has shown the disease to be prevalent, more particularly in Assam, Bengal, and Behar, to an extent hitherto unsuspected The number of cases treated has steadily increased as the benefits of treatment have become known, until the total for 1924 in Assam and Bengal alone has exceeded 100,000 treated cases But this probably represents only a portion of the actual incidence of the disease There is reason also to believe that even in recent years kala azar has extensively invaded new tracts, *e g* whilst in 1910 only a few foci were to be found in Upper Assam, infection in the villages of the southern portion of this area is now almost universal There is no question, therefore, as to the menace of this disease, which has something of the relation to India that sleeping sickness has to Africa.

It may interest readers of NATURE to know that this state of affairs has received very serious attention in India, both in respect to efforts to cope with the fatal effects of infection by special measures for supplying treatment, and in regard to scientific investigation with the view of discovering the method by which the disease is transmitted Formerly kala azar was classed as an untreatable and almost necessarily fatal disease Since the discovery of the effect of tartar emetic in treatment, a large proportion of cases now yield to this drug, and the beneficent action of Governments in providing treatment has had an immense effect in the saving of life, though it has not apparently had any measurable effect in decreasing the incidence of kala azar, as was at one time hoped The scale on which treatment has been organised will be appreciated from the colossal total of treated cases already given, which represents for the greater part cases of kala azar treated near their own homes in the often remote infected villages, and cases which would otherwise have been unable to avail themselves of treatment even had the benefits of such been known to them In Assam particularly, where the organisation for kala azar treatment has developed into one of the most remarkable efforts in ameliorative medicine in modern times, legislative measures have been freely taken, including an organisation for survey and notification and compulsory treatment where necessary The need for the latter, however, has steadily disappeared as the benefits of treatment have become known. In addition, improvements in treatment which have largely originated in India promise in the future still further to rob kala azar of some of its terrors, for by the use of special antimonial compounds, *e g* urea stibamine, the percentage of successful treatments can be increased to include all but some 1·0 per cent of the 10-15 per cent of cases resistant to the ordinary method of treatment by tartar emetic By the use of these drugs also the necessary period for treatment is reduced from a tedious period of three months to one of a month or less

Unfortunately, treatment of what is probably only a percentage of the actual number of cases, however effective to the individual sufferer, appears to hold out very little hope of preventing the continued spread of the disease, and effective preventive action can scarcely be successful until the method in which kala azar is contracted is known. The need for research on these lines has been all along appreciated in India, where, apart from the earlier work of Donovan, Rogers, Patton, Row, and others, there has been for the last ten years almost continuous investigation in the form of a Kala Azar Inquiry that has worked under officers well known as protozoologists and workers on insect-transmitted diseases. In October 1923 it was decided at the annual meeting of Research Workers of India that kala azar should receive attention as a priority research, and a draft constitution for a Kala Azar Commission was drawn up and submitted to Government The Commission, financed by the Indian Research Fund Association and the different interested Provincial Governments, was constituted early in 1924, and has since been at work chiefly in Assam, where the facilities for the study of the disease are specially great In connexion with the Commission is an ancillary inquiry at the School of Tropical Medicine, Calcutta, constituted by Major R Knowles, I M S, Dr L E Napier, and Assistant Surgeon R O A Smith This inquiry, led by their previous epidemiological work to suspect either the sandfly (Phlebotomus), or the minute midges Culicoides, as the transmitters of the disease, were able to show that the parasite of kala azar develops with great certainty and ease in the sandfly *P argentipes*. The investigation of the relation of these insects to kala azar transmission is now taking first place in the researches of the Commission, who have already confirmed the results of the ancillary inquiry that sandflies of the above species fed on the peripheral blood of kala azar cases, in about 25 per cent of those fed, develop infections of the mid-gut with the flagellate form of the parasite These infections by the fifth day after feeding may be so heavy as to be comparable with the condition seen in culture and in natural infections with Herpetomonas

There remains, however, much to be done before the sandfly can be stated definitely to be the transmitting agent, for the method in which the parasite re-enters man is still unknown, nor has it yet been shown by experimental feeding or otherwise that infection can result in this way Extensive investigation is also necessary even when the carrier has been demonstrated before practical results can be achieved in prevention The Commission, though now working in Assam, will undertake researches in turn or simultaneously in other provinces, in order that full advantage may be taken of comparison of the conditions in as many areas as possible It is understood that the investigation under the Royal Society will in part at least be carried out in collaboration with this Commission, thus greatly strengthening and assisting the action already taken by India for the investigation of kala azar.

S R CHRISTOPHERS

Series Spectra of Two-valence-Electron Systems and of Three-valence-Electron Systems.

WE have recently been able to prove that the following laws first discovered in the X-ray field, namely (1) the Moseley law, (2) the regular-doublet, or Sommerfeld, law, and (3) the irregular-doublet, or Hertz, law, hold also throughout the whole field of optics, provided only the radiating atoms under comparison have the same electronic structure but varying nuclear charge

We have further been able to obtain in our "hot-spark" spectroscopy long series of such atoms of like electronic structure, such as the seven stripped atoms Na I, Mg II, Al III, Si IV, P V, S VI, and Cl VII, a stripped atom being defined as an atom robbed of all its valence electrons save the one that, by jumping between the series of energy levels characteristic of the atom, gives rise to the observed spectrum (Millikan and Bowen, *Physical Review*, January 1924, September 1924, April 1925)

We have also found the foregoing X-ray laws, especially the irregular doublet law, powerful means for the interpretation of complicated spectra, *i e*, for the picking out of the lines due to particular electronic jumps in atoms in various stages of ionisation.

We have thus recently worked out and published the fairly complete spectra of a considerable number of stripped atoms

In the present note we present the condensed results obtained by the extension of the same method to two more series of atoms of like electronic structure, namely, two-valence-electron systems, such as Mg I, Al II, Si III, P IV, S V and Cl VI, and three-valence-electron systems such as Al I, Si II, P III, S IV, and Cl V The method of obtaining these results will be presented in detail in forthcoming articles, but the term values divided through in each case by the square of the effective nuclear charge are presented in the following tables, from which, however, Cl V and Cl VI are omitted because not enough lines have been identified to permit of the complete working out of term values

TABLE I

COMPARISON OF TERM-VALUES OF A SERIES OF ATOMS CONSTITUTING A TWO-ELECTRON SYSTEM, Mg I, Al II, Si III, P IV, S V

	N R/N^2	3· 12192 78.	4 6858 44	5 4389 40
s	Mg/1		20474 5	9799 3
	Al/4		15147 3	7942 64
	Si/9		12962 5	7096 0
	P/16		11730 5	6592 5
	S/25		10923 0	
p_1	Mg/1	39760 5	13820 0	7419 0
	Al/4	28570·3	11598 17	6535 34
	Si/9	24097·7	10522 5	
	P/16	21622 8	9864 1	
	S/25	20019 9	9407·7	
d	Mg/1	13714 7	7479 5	4704 1
	Al/4	14078 41	7595 02	4760 18
	Si/9	14121 4	7604 4	
	P/16	14074·1	7583 2	
	S/25	13988 0		
f	Mg/1		6994 8	4469 0
	Al/4		7109 90	4603 27
g	Al/4			4419 45

TABLE II.

COMPARISON OF TERM-VALUES OF A SERIES OF ATOMS CONSTITUTING A THREE-ELECTRON SYSTEM, Al I, Si II, P III, S IV

	N R/N^2	3 12192·78	4 6858·44.	5 4389·40
s	Al/1	·	22933 27	10591·58
	Si/4		16580 8	8462·9
	P/9	·	13944 2	7477 0
	S/16	·	12506 8	6908 2
p_1	Al/1	48168 87	15316 48	8003 24
	Si/4	32882 8	12643 0	·
	P/9	26974 7	11313 5	·
	S/16	23787 0	10489 0	·
d_1	Al/1	15844 15	9347 22	6043 31
	Si/4	13119 5	7700 0	·
	P/9	14050 0	7878 3	
	S/16	14337 5	7884 5	·
f	Al/1		6962 6	4451 5
x	Si/4	19124 5		·
	P/9	15903 9		·
	S/16	16127 3		·

I S BOWEN
R A MILLIKAN.
Norman Bridge Laboratory of Physics,
California Institute of Technology, Pasadena.
February, 1925.

Losses of Ammonia from Soil by Volatilisation.

THE present communication is a preliminary note on the subject of the loss of volatile constituents from soil, which it is proposed to investigate in detail and on a large scale in the immediate future

It has, of course, been known for long that while the growth of grasses and tree vegetation on an undisturbed soil produces increases in the nitrogen content of the soil largely owing to the activity of a series of nitrogen fixing organisms, the cultivation of a soil in which the nitrogen equilibrium point had been raised by quiescence invariably results in a loss which was not recoverable in the crop

In this way there is a leakage of nitrogen which represents a serious economic loss This occurs not only in Great Britain, but is even more pronounced in those countries where climatic conditions are such as to cause a very complete desiccation and aeration of the surface layer

It was shown by Hall and Miller (*Journal of Agric. Science*, iv 56) that when dishes of sulphuric acid were exposed above the soil there was a small absorption of ammonia which was supposed to come from the atmosphere They observed that very considerable quantities of ammonia were given off from the soil as a result of an application of ammonium salts, and they conclude that "if the soil is palpably giving off ammonia during the months immediately following the ammoniacal manuring it must still be doing so at other times of the year"

It has been shown previously by one of us (Oxford Forest Memoirs, No 2) that in those soils which contain large quantities of ammoniacal nitrogen there is a considerable portion of this which can be easily removed by solution in water, and further, that when the total amount of ammonia increases during desiccation, as is normally the case, the larger part of this increase is in a form in which it can be removed by water alone

	Moist	1st Period	2nd Period	3rd Period.
Total ammonia	11 parts per million of dry soil	16	19	22
Water Soluble Ammonia	10 „ „	13	16	19
Solubility percentage	90 9 „ „	81·25	84 2	86 38

These figures show an increase in total amount of ammonia, which is largely composed of ammonia so little retained by the soil that upwards of 80 per cent. is removed by solution in water alone. The drying of these soils was carried out slowly and without aeration

During the desiccation the increase of ammonia did not appear to be due to denitrification, as there was an increase in the nitrate content as well during the time of drying.

	Moist	1st Period	2nd Period	3rd Period
Nitrate	49 parts per million of dry soil	53	69	69
Increase as percentage of initial concentration	- -	8 2	40 8	40 8

These results and others which arose in the course of an investigation into the presence of phenols in the soil, and the observations of Hall and Miller, already quoted, led us to carry out a series of experiments in which attempts were made to aerate the soil under different temperature conditions, and to determine whether any volatilisation of ammonia could be detected

The results of the first series, carried out with dry air at room temperature, are given below The dehydration of the soil in these took place slowly

Soil	Crop	Season	P_H	Total NH_3	Soluble NH_3	Volatile NH_3	Moisture lost during Dehydration as per cent of Dry Soil
				p p m			
Forest	Tsuga	Winter	5	5 7	2 1	1 45	30
,,	Corsican Pine	Spring	4	4 95	1 5	2	35
,,	Oak	Spring	7	2 4	8	8	30
,,	Larch	Summer	4	8 8	4 8	2	41

The second series were carried out with different soils and the aeration was effected by a current of dry air, the temperature of this and of the soil being maintained above 50° C

Soil	Crop	Volatile NH_3, Parts per million of Dry Soil	Moisture lost during Dehydration as per cent of Dry Soil
Egypt	Cotton	1 1	15
Chalk	Barley	5	12
Marlstone	Pasture	5	31
V rich Hothouse		1 5	62

These figures again show a considerable amount of ammonia volatilised from the soil

An apparatus is in the process of construction which will deal with large quantities of soil, and it is hoped, will enable an extended series of observations to be made with soils of different types and at different temperatures.

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Robert Browning as an Exponent of Research.

I HAVE read with delight Mr Lamplugh's glowing appreciation (NATURE, February 28) of Browning's sympathy with scientific thought, and I agree with every word except that one searches vainly in "Paracelsus" for any clear appreciation of scientific research For more than forty years I have felt that that poem breathes throughout the very spirit of scientific enthusiasm which is the mainspring of research Paracelsus first "aspires"

To contemplate undazzled some one truth,
Its bearings and effects alone—at once
What was a speck expands into a star,
Asking a life to pass exploring thus

When he "attains" fame in the world he is struck with fear that his ideals may have declined with his lost youth and hopes, and exclaims

Would I were sure to win
Some startling secret in their stead, a tincture
Of force to flush old age with youth, or breed
Gold, or imprison moonbeams till they change
To opal shafts !—only that, hurling it
Indignant back, I might convince myself
My aims remained supreme and pure as ever !

In mature age he "aspires" again, looking back over more disappointments than triumphs, and the old passion swells up once more, struggling under the rein of reason

And I betake myself to study again
Till patient searchings after hidden lore
Half wring some bright truth from its prison , my frame
Trembles, my forehead's veins swell out, my hair
Tingles for triumph Slow and sure the morn
Shall break on my pent room and dwindling lamp
And furnace dead, and scattered earths and ores ,
When, with a failing heart and throbbing brow,
I must review my captured truth, sum up
Its value, trace what ends to what begins,
Its present power with its eventual bearings,
Latent affinities, the views it opens,
And its full length in perfecting my scheme
I view it sternly circumscribed, cast down
From the high place my fond hopes yielded it,
Proved worthless

Finally, when he "attains" to wisdom while dying in poverty and neglect, Paracelsus, "the searching and impetuous soul," reviews his career of discovery and traces the course of Nature from the time when

The centre fire heaves underneath the Earth
And the Earth changes like a human face,

and onward in a fine description of the origin of land, the advent of plants and animals and their development,

Suggesting some one creature yet to make,
Some point where all those scattered rays should meet
Convergent in the faculties of man

Surely this is not only appreciative but prescient also of scientific thought, for Browning wrote the poem in 1835 when Darwin was still sailing the seas, an unknown assistant-surgeon on the *Beagle*

HUGH ROBERT MILL

February 28

The Translation of Helmholtz's Physiological Optics.

THE reviewer of Helmholtz's "Physiological Optics" (NATURE, December 20, 1924, p 887) remarks, "at last a deep reproach has been lifted from the record of English scientific literature"

Nearly quarter of a century ago (on returning from three years' work in a German scientific institution), I proposed to Messrs Longmans that I should write a translation for them to publish They agreed, and secured the services of Sir Michael Foster to edit the work, and bring it up-to-date Sir William Abney and other scientists warmly supported the idea The German publishers also were quite willing, and agreed to lend their clichés The scheme fell through because the heirs of von Helmholtz, after long delay, refused to grant the rights of translation, acting on the advice of Prof Arthur Konig I forget the exact terms of Konig's letter, but it was to the effect that the book dealt with researches which had not been completed, and therefore it would be unfair to the memory of von Helmholtz to allow it to be presented to English readers as representative of his work

ALICE EVERETT

Teddington, Middlesex,

February 17

The Historical Succession of Cultural Impacts upon South Africa.

By Prof. RAYMOND A. DART, University of the Witwatersrand, Johannesburg, South Africa

SINCE their discovery by the ivory trader Adam Renders (1868) the famous Zimbabwe ruins in Rhodesia have formed the rallying-point around which a fierce and even bitter controversy has raged amongst anthropologists and others The central point at issue is whether these stately relics owe their existence to an endogenous civilisation, which has since vanished, or to an external and highly advanced culture the impact of which, though powerful, was gradually and ingloriously diminished at a remote historical period.

The conflict which has proceeded about this issue has been valuable in causing suggestive data of considerable magnitude to be placed upon record It has revealed the existence of a stupendous enterprise in mining of gold, copper, tin, and pigments which involved virtually the whole territory from the Belgian Congo on the north to the Central Transvaal on the south, and from the Kalahari Desert in the west to the Portuguese East African coast in the east These undertakings were prosecuted with a finesse which never fails to command the respect of modern engineers Rhodesia, the centre of the mining area, is found at the present time to be pervaded by extensive monumental remains in the form of monoliths, stone circles, and stone buildings, together with vast areas of terraced cultivation In many instances the buildings reveal a nicety of architecture and a regard for sanitation such as are not characteristic of Southern African natives Moreover, the ornamentation and objects of phallic worship found in numerous sites have betrayed to many the influence of a people with artistic feeling, and with a complicated theology and religious ritual, who were probably Phœnician, coming from Sabaea in south-eastern Arabia.

Important as the information at our disposal may be, we are far from an exact knowledge in any of the fields involved in this evidence There has been as yet no systematic anthropological survey of even a portion of the territory involved In the absence of detailed and precise data, it has been easy for ill-informed argument to accumulate and the significant issues to be overwhelmed in a sea of conjecture

It is at this juncture that the painstaking and tireless investigations of a Trappist monk of the Marianhill Monastery in Natal appear to provide decisive information such as has been so long searched for Equipped with the knowledge of an artist skilled in reproducing and retouching medieval works of art in the Cathedrals of Cologne, Bonn, and elsewhere, Brother Otto has been copying with infinite patience for some years the Bushman paintings found in the rock shelters of the Kei River Valley, in the eastern portion of the Cape Province Copies of certain of these he has forwarded to me with notes for the purposes of this article

Bro. Otto is not the first investigator who has worked in this region Stow visited a number of the caves here, and another priest, P M A Schweiger, R.M M, published (*Anthropos,* 1913) certain of the paintings which Bro Otto has since studied more minutely It has remained, however, for Bro. Otto to reveal the historical significance of these works of art

In the first place, Bro Otto believes he is able to prove that the art of painting was indigenous to this country, and was not introduced from outside. The works which illustrate the beginnings of the art are crude drawings in charcoal, chiefly of animals, and later of naked human forms revealing the well-known Bushman characteristics Apparently, by experimenting with pigments mixed with the juices of the Euphorbia flora, works were executed with exceedingly fine brush technique The pigments, of which a considerable variety was utilised, seem finally to have been rendered impervious to the passage of time and the most rigorous climatic exposures by the discovery of the value of oil as a medium, until latterly the finest works were executed indifferently in the recesses of shelters or on the weather-beaten faces of the rocks outside

These matters are important enough, but a greater human interest attaches to the discovery that, after their technique had become perfected, the Bushman found subjects for artistic exploitation in voyagers who visited their coasts and inland rivers at a period

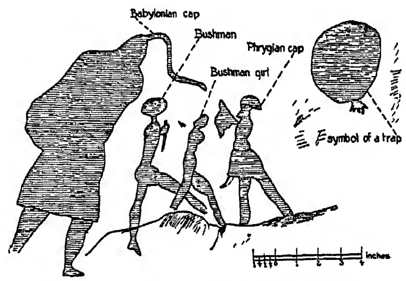


FIG 1—Bushman painting in deep red monochrome, in a cave near the confluence of Ngolosa and Kei Rivers (After Bro Otto)

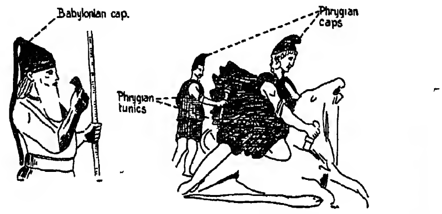
so remote in time that paintings depicting them are sometimes found to be partially covered by an incrustation one-sixteenth of an inch in thickness

From twenty-eight separate sites over an area twenty miles in length along the Kei River, Bro Otto has collected more than two hundred and fifty copies of painted groups, and has not omitted, to his knowledge, any detail depicted by these primeval artists within this circuit From this mine of material he is in a position to provide authoritative information concerning the homeland of these visitant navigators of early times

A picture from a cave near the confluence of the Ngolosa and Kei Rivers in the Cape Province is represented in Fig 1. Here we find the figures of two naked Bushmen, and of two foreigners—gigantic in the Bushman's estimation, and wearing ancient Asiatic tunics and headgear The painting depicts a scene in which a piece of clothing is about to be cast over a nude Bush maiden by a bearded man dressed in a Phrygian tunic and cap, and carrying a weapon (sword ?) Opposition is expressed in the antagonistic attitude of the naked Bushman, who carries a stick in his hand, while the operations are followed closely by the other massive figure, also clad in a tunic, but

wearing a cap of Babylonian design This figure has no weapon, and is presumably that of a merchant captain. Other pictures of similar alien intruders show them to be usually bearded and armed with bows and arrows, shields, and other weapons—swords and javelins,—whereas the Bushman in these old pictures is generally unarmed or is armed only with a stone or a stick. It seems possible from these facts that the Bushman learned the use of the bow from such visitors

It is amazing to find that the clothing and headgear



FIGS 2 and 3—On the left, figure of Marduk, original in the Berlin Museum (After Birkner, "Rassen und Völker") On the right, Mithras slaying a bull, original in the Louvre, Paris (After Hochland)

of the people depicted in this painting have their counterpart upon the bas-reliefs of Babylonia and the ancient paintings and sculptures of the Mediterranean area (see Figs 2 and 3).

It is perhaps equally remarkable that no inferences have been drawn from pictures already published similar to those in the possession of Bro Otto More than twenty years ago there appeared in the "Natal Railway Guide" (1903, p 216) a picture (Fig 4), photographed in Natal by J E. Middlebrook, which presented the same striking juxtaposition of naked Bushmen and clothed Asiatics of the Babylonic-Phœnician period. This photograph was reproduced for the purposes of an article by D. Waterston in the *Scientific American* (1915, p. 191) In the meantime, as mentioned already, another priest, Albert Schweiger, had published (*Anthropos*, Bd VIII, 1913) numerous pictures portraying the presence of clothed foreigners

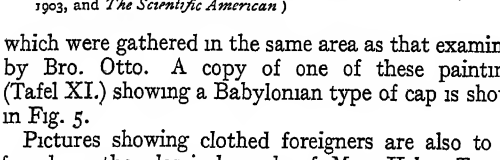


FIG 4—Bushman painting from Natal revealing contact of Phœnicians with Bushmen (After photograph from the "Natal Railway Guide," 1903, and *The Scientific American*)

which were gathered in the same area as that examined by Bro. Otto. A copy of one of these paintings (Tafel XI.) showing a Babylonian type of cap is shown in Fig. 5.

Pictures showing clothed foreigners are also to be found in the classical work of Miss Helen Tongue ("Bushman Paintings," Oxford, 1909). This author has published many plates of paintings copied in the eastern part of the Orange Free State and Cape Province. Plate XV, No 102, of her work presents a "procession of men and women dressed in cloaks" The faces of the members of the procession are painted white—a feature of no small significance when it is recalled that Bushmen generally represented themselves and other African natives by means of a black or a scarlet pigment Bro. Otto's experience agrees with that of Miss Tongue and of J. E. Middlebrook (*vide* Fig. 4) in finding the features of these alien personages depicted usually by means of a white pigment

We have seen, then, from the independent evidence of at least four people, that foreigners who were clothed in Phœnician and even Babylonian garb were well known to the aboriginal Bushmen of the Eastern Cape Province, Orange Free State, and Natal But perhaps the most beautiful reproduction of a Phrygian cap was discovered by Father Krauspenhaar a thousand miles north of this region, in Rhodesia, at Rusapi, which is situated on the Beira-Salisbury railway some two hundred miles inland. Fig 6 is a drawing of Father Krauspenhaar's copy of this picture.

In a portion of the same area (Barkly East) as that examined by Miss Tongue are many pictures of clothed and capped Phœnician foreigners, some of which have been reproduced in Dr O Moszeik's "Malereien der Buschmänner" (Berlin, 1910, pp 61 and 66) Barkly East is situated on a tributary of the Orange River

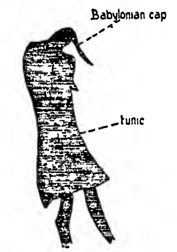


FIG 5—Bushman painting from "Nthintshi" near Kei River, Cape Province, depicting a foreigner (Schweiger)

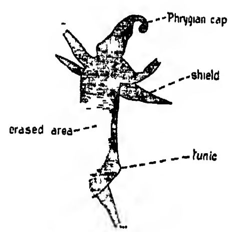


FIG 6—Bushman painting in monochrome red from a cave near Rusapi, Rhodesia (After P F Krauspenhaar)

nearly two hundred miles inland, and consequently we are now in a position to state that the whole of the eastern portion of the African continent for some hundreds of miles inland, which lies between the latitudes of the Zambezi on the north and the Orange and Kei Rivers on the south, was exploited by the *old-colonists*, as Bro Otto terms them, from South-west Asia in remote ancient times He calls them *old-colonists* because he believes he is able to prove conclusively from the paintings that these very ancient voyagers not only visited these territories and carried off their denizens, particularly their women, but also intermarried with them and settled down amongst them, bringing to them novel arts and customs (Fig 7)

The significance of these observations for the unravelling of the Zimbabwe riddle is not far to seek, for they reveal the unsound nature of Randall MacIver's theory of medieval and even Bantu origin of the ruins, mines, and agricultural terraces south of the Zambesi The pictorial art of the Bushman has preserved through the lapse of centuries unassailable evidence of the impact of ancient civilisations of the Eastern Mediterranean and Mesopotamian areas upon a Bushman South Africa which betrayed in their day no evidence of Bantu contamination

One of the supposedly crucial pieces of evidence

adduced by MacIver in support of his hypothesis of a medieval Rhodesia, the culture of which was of purely Bantu origin, was the constantly recurring discovery of Chinese porcelain in these ruins The presence of this ware was rather naturally attributed to Portuguese influence But the Chinese were navigating the Indian and Pacific oceans in luxurious fashion in the days of Marco Polo, when the Princess Kokáchin went by sea from China to Persia Nearly three centuries before Marco Polo's time, Alberuni (about A.D 1030) records that "The reason why in particular Somanâth (in India) has become so famous is that it is a harbour for seafaring people, and a station for those who went to and fro between Sufâla in the country of the Zanj and China" (E C Sachau, 1910, vol 2, p 104) Indeed, the timid writer of the Periplus found his way south along the African coast so far as Rhapta in the first century of our era, and relates of Arab captains and agents at that period "who are familiar with the natives and intermarry with them, and who know the whole coast." There is every reason for believing that

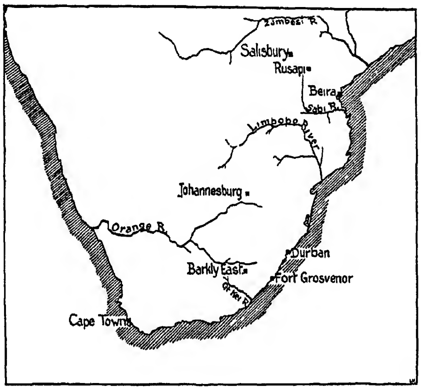


FIG 7

in the early centuries of the Christian era, and perhaps prior thereto, when Chinese arms were pushing far westward upon land, Chinese shipping was contesting with Indian and Arabian vessels the trade of the East African coast, which had already fallen from the hands of Egypt and Mesopotamia and those who brought and carried for these countries

Fig 8 is a copy of Miss Helen Tongue's Plate XVIII, No 27, of which she states that "the whole appearance of this painting is ancient" The present interest lies in the fact that it portrays a man of light brown complexion, adorned with two necklaces, arrayed in sumptuous apparel, and carrying on his head a peaked Chinese hat. Bro Otto has also discovered a number of pictures (*e g* Figs. 9 and 10) showing this unexpected type of headpiece. In the light of all these facts it must be recognised that MacIver's hastily drawn conclusions are utterly inadequate to explain the ethnological problems of the southern end of this continent.

That Rhodesia was brought into contact directly with Arabian and Indian agricultural products is shown by the fact that vines, lemons, figs, and cotton, though not indigenous to South-east Africa, are found on the terraced hills of Inyanga in Rhodesia "Livingstone, Chapman, Burton, Kirk, and all authorities on Zambesia down to the present day have called attention to the great number of plants, fruits, and trees of Indian habitat to be found together on the Rhodesian gold-mines area These are, of course, not indigenous to this country: the now wild *Tonge manga*, a cotton of Indian origin, not the *Tonge cadja*, which is indigenous, also a bean, *Cajanus Indicus*, known in India as the Dhal Plant, the Indian fig, grown wild; and a tree, *matuwi*, found elsewhere only in India. There is also the *Mahobohobo*, which has its habitat only in Southern India and Malaya In Rhodesia this tree is only found on the area of the prehistoric rock mines, but the vast extent of the country now covered by its forests demonstrates that it arrived in some exceedingly remote time" ("Guide to Rhodesia," 1924)

Whether Chinese pottery reached Rhodesia by a European or, as is more likely, by a more direct route past India and Arabia, the discovery of it affords us little light upon what was taking place in Southern Africa long before European and even Indian and Chinese contact was possible, and it is precisely here that the evidence accumulated by Bro Otto is of premier significance, seeing that it demonstrates an extremely ancient cultural impact upon the aboriginal Bushman

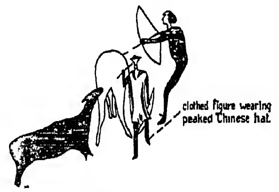


FIG 8 — Bushman painting in light brown and dark brown, from Magdala, near Barkly East (After Miss Tongue)

These remarkable pictures also bring into their proper perspective a series of discoveries of a different but allied nature which have been inadequately appreciated hitherto

FIG 9 — Bushman painting on a stone block, Eliweni, Kei River, depicting a foreigner

FIG. 10 — Bushman painting in black from cave on the White Kei River, Cape Province, depicting a foreigner

About fifty years ago, Mr. Thomas Cook, who is still living in Durban, discovered twenty-eight coins in a calabash at a depth of about six feet, on the site of a native hut, near the beach at Fort Grosvenor in Eastern Pondoland Many of these were so worn that their inscriptions were illegible—illustrating that they had been much handled—but some, which were legible, were described by Mr. G F Hill, of the British Museum, in the *Classical Review* (of 1897 or 1898). The oldest three coins were of the period of Ptolemy I, II, and IV respectively (*i e* 304–204 B.C), and the other coins examined were Roman coins issued between the dates A D. 296 and 313, five of them being struck at Alexandria, two at Antioch in Syria, and one at Cyzicus

This discovery is not the only one of its kind, for when the monks were building their water reservoir at Marianhill, twenty-six miles from Durban, they found, at a depth of eighteen inches in a recent stratum

of sand and humus on the side of a hill, a Hebraic coin of the reign of Simon Maccabæus (143–136 B C), with the inscription "fourth year of the deliverance of Sion" (*Anthropos*, Bd V, 1909, p 168)

Now it is conceivable that stray Egyptian, Maccabæan, Syrian, and other coins might percolate even to extreme Southern Africa without any intense cultural movement being afoot, but coins generally signify commerce, and the most cursory examination of any map of Africa south of the Zambezi will show that Palestine and Arabia—those homes of commerce —have left behind very clear evidence of a lengthy contact with this part of the globe It is by no accident such as might conceivably determine the movement of coins, nor by any philo-Semitic proclivities of the Portuguese, that we find in Portuguese East Africa and the countries adjacent thereto place-names such as Antiocha, Jacobecua, Jacoja, Jacota, Gadsane, Gadzema, Jofane, Gaza, Gizha, Sinoia, Jobo, and the like The two rivers Sabi and Sabie as well as Lake Sibai, together with Sabia, Sabetsi, Sebaba, Sebakwe, Shebekwe, Shibuto, Shibabara, Chabane, Chiba, Chibi, Chibambala, Chibababa, and so on, owe their names to a people fascinated by the central root Saba, Seba, or Sheba, just as the Dutch have left in South Africa their "fonteins" and "burgs," the English their "Londons" and "Cambridges," and the Scotch their "Dundees" and "Glencoes." So, too, Masibi, Mazibi, Mazibila, Masipe, Mripa, Mriba, and Mareba have an intimate relation with Marib, in the same way as Mocuba, Mokuba, Mkubi, Namoko, Makiki, Muchacha, Machiche, and Machacane recall the Arabian Mocha.

In brief, the themes for the variations provided by hundreds of place-names south of the Zambezi lie in the Asiatic continent, and still await the investigations of specialists in this field. The evidence to be culled from this study will be especially valuable in "dating" and "placing" the different cultural intrusions. Many of the Arabian names are undoubtedly pre-Koranic. In addition to names from Western Asia, there are Indian types such as Ricatla, Mandle, and Kande, and variants of the old name of Japan (Zipangu), namely, Chipanga and Chipinga. I have entered into this matter of place-names in some detail because, rich as the field obviously is, I am not aware of any serious study of this sort made hitherto upon this locality.

FIG 11—Bushman painting from "Ngolosa" (Kei River), revealing Egyptian characters in clothing and head-dress (After Schweiger)

We have considered already evidence which indicates that, prior to the coming of the European, not only medieval Arabian, but also Indian, Chinese, pre-Koranic Arabian (Himyaritic-Sabaean), Palestinian, Phrygian, and even Babylonian influences have played a part in moulding the destinies of the primitive peoples of Southern Africa. There are not lacking evidences that Egypt, too, was in intimate contact with this remote region. There is one picture of Schweiger's from the Kei River Valley (Fig. 11), in which the head-dress, clothing, and artistic feeling is positively Egyptian. However, I would have disregarded this picture if I had not been arrested while in Marianhill by the persistence of the same Egyptian fashions of head-dress amongst the native women at the present day. The photograph reproduced in Fig 12 reveals Egyptian characters not only in the head-dress

FIG 12—Native women, Marianhill, Natal, showing Egyptian characters in head-dress and clothing.

and the head-ring, but also in the clothing (suspension at the waist, fringe at the lower margin), and even in the features of one woman, the other looks Semitic, but neither is frankly Negroid or Bushmanoid For comparison with Figs. 11 and 12, I have reproduced one of the figures in the procession of servants of the Queen Hatshepsu who visited the Land of Punt (Fig 13).

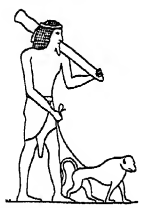


FIG 13—Figure in procession of Queen Hatshepsu's servants, to illustrate Egyptian head-dress and clothing

In this connexion, it will be recalled that Dr Karl Peters discovered (Keane's "Gold of Ophir") in Rhodesia a figurino of an Egyptian courtier—of the period of Thothmes III. (Dynasty XVIII)—holding in his hands the scourge of a slave-driver. Further, most authorities concur in believing that the steatopygous Queen of Punt and her daughter portrayed in the spoils of the voyage of the sister of Thothmes III, Queen Hatshepsu's (1501–1479 B C) servants to the divine South-land, was a Bushwoman or closely related to one. Thus Sir Flinders Petrie ("History of Egypt," vol. 2, 1899) says, "The strange fatness of the queen has been much speculated upon, whether it was a disease such as elephantiasis, or was natural fat, has been debated; but as her daughter shows much the same tendency of

curve in the back, it is probably the effect of extreme fat, which was considered a beauty, as in South Africa at present" Rawlinson (*Ancient Egypt*, 1893) is still more emphatic when he states, "She belonged, more probably, to one of the dwarfish tribes of which Africa has so many, as Dokos, Bosjesmen, and others"

The land of Punt is generally supposed to have been south-eastern Arabia or some point along the southern Somali coast, the spices, resins, and incense products being in favour of the former, the giraffes, ivory, cynocephalous apes, and the like speaking for the latter. Frobenius ("Das unbekannte Afrika," 1923) has shown in a map the distribution of houses on piles such as were seen by these voyagers to Punt None such are to be found in Arabia or Somaliland, but they are found on the big rivers of Africa southward from Somaliland Resins and snuffs have the highest of values amongst the Bush people even in modern times I do not say that the data are conclusive to prove that God's land, Punt, lay in Africa south of the Zambezi, but the facts are highly suggestive The products of the country—people, animals, gold, resins, pigments, and the like—were such as this country certainly was affording in plenty at that remote period At the same time, it is a well-recognised fact that for centuries, perhaps millennia, prior to Queen Hatshepsu, ships had been navigating the Red Sea, the open ocean, and the Persian Gulf between Egypt and Mesopotamia It is not reasonable then to imagine that the Egyptian queen would render herself a laughing-stock before the civilised world by celebrating in the building and decoration of a new temple as extravagant marvels the products of places near by like the coasts of Arabia and Ethiopia To fit out an expedition for this remote South-land of Punt was always an epochal event, and was carried out only by the greater Pharaohs in times of peace and prosperity, and was even then worthy of record Such expeditions are recounted in the times of Sankh-ka-ra (Dynasty XI) under the nobleman Hannu, of Hatshepsu, of Thothmes III—the Napoleon of Egyptian history—and of Horemheb (all three of Dynasty XVIII), and of Rameses III (Dynasty XX) It is absurd to believe that these proud names in Egyptian history would reckon trips to little beyond the mouth of the Red Sea as worthy of mention when the equipment of voyages three years in duration were commonplaces in the chronicles of the pigmy court of Solomon Even in the humdrum days of Herodotus, one circumnavigation of Africa had not been entirely forgotten, for he relates how King Necho's Phœnician servants had accomplished this hardy feat

His Honour the Administrator of the Transvaal (Prof. Jan H Hofmeyr) has informed me that the remains of what was presumably an ancient galley were discovered during the laying out of the Maitland Cemetery on the Woltemade flats near Cape Town in the 'nineties. At that time the contact of one end of Africa with the other by navigation was undreamt of, and the significance of finding a boat, one hundred and eighty feet in length, buried six feet underground at a distance of three miles from the present coast-line, was lost on the workmen, who utilised it for firewood The event at least indicates that the followers of Prince Henry were not the first to anchor in Table Bay

The continuity of the Atlantic and Indian Oceans around the southern extremity of Africa was customarily portrayed by the ancient cartographers of Greece (*e g.* Globe of Crates), of Arabia (*e g.* Idrisi), and of Europe from Venice to Anglo-Saxon England (*vide* "Encycl Britt") It is difficult to understand how such conceptions could have grown up and persisted in this fashion unless the experiences of ancient voyagers had provided some foundation for them It is likely that the voyage of Necho's servants was but a repetition of many similar ventures in the storied past In any case the tale provided by Herodotus is more easily believed when we know that Bushmen from the Zambezi to the south-eastern corner of the continent on the shore-coast and for hundreds of miles inland have recorded in portrait the arrivals and the activities of not merely one but untold numbers of invaders at successive historical epochs.

It is not in the contact of any one people but in the endless procession of emissaries of every great navigating power in the Indian Ocean down this coast that one finds an explanation of the prodigious extent of the early mining industry of Southern Africa. Moreover, it is only in terms of this procession that the physical, anthropological, and ethnological problems of this country can be adequately understood. It is impossible here to do more than direct attention to certain aspects of these intricate but highly fascinating studies It has already been stated that no exhaustive anthropological survey of the region concerned has been made; but if the urgent necessity for such a survey of the paintings, ruins, terraces and mines, and the nature and richness of its prospective fruits, are indicated, these meagre notes will have been justified

Biographical Byways.[1]

By SIR ARTHUR SCHUSTER, F R S

12 ESMATT EFFENDI

I AM not aware that any publication of Esmatt Effendi has ever seen the light of day, but nevertheless my readers, I hope, will agree that his name deserves to be included in this collection of reminiscences He certainly possessed two essential qualities, enthusiasm and perseverance I made his acquaintance at Suez, on the evening of May 3, 1882, when, on behalf of the Khedive of Egypt, he received a party sent out under the auspices of the Royal Society to observe the total eclipse of the sun that was to take place on May 17 at Sohag, some way up the Nile He gave us a very promising account of the local facilities, more especially with regard to bricks and mortar for the foundations on which to place our telescopes, and if his predictions did not come true, and the only brick we saw was that aimed at the head of one of the party by an inhabitant of the village, his intentions were undoubtedly good

Esmatt Effendi had an ambition to learn something about astronomy, and showed great interest in a

[1] Continued from p 385

sextant that I had taken out to check our chronometers He begged me to teach him its use After a few lessons, I found him one day trying to find the image of the sun in an artificial horizon, having pushed all dark glasses out of the way I had warned him against this, and got rather angry with him He replied, "I am an Egyptian, and I cannot see the sun with the dark glasses When an Egyptian says he is going to do something he is going to do it, and I am going to see the sun through this sextant even if I lose my eyesight" I had to lock up the sextant

It was some years before I heard of Esmatt again. Through diplomatic influence, the Naval Observatory at Washington had been persuaded to take him in as a kind of apprentice. They found him, as I had done, persevering and enthusiastic, but incapable of assimilating any knowledge They tried to persuade him to return home and take up some other occupation, but Esmatt Effendi had made up his mind to stay The authorities of the Observatory learned afterwards that all the time he was half starved, and had to sell his books and a great part of his clothing to pay for his board and lodging Matters ultimately reached a crisis and he was told to leave He finally consented, on condition that the authorities would give him a testimonial which would enable him to find a position at home. They considered the matter, and ultimately resolved that it was worth while to stretch a point, and they sent him the requested testimonial To their surprise, they found Esmatt again at his desk next morning He was reminded that they had kept their part of the bargain and that he must keep his Esmatt stood up, took the testimonial out of his pocket, waved it in front of their faces, and said, "The man who deserves this testimonial deserves to work in the Observatory of Washington." The rest of this story, which I give on the authority of one of the principal astronomers concerned, must be left to the imagination

CONCLUSION.

It is with some hesitation that I conclude these reminiscences with the account of an incident that revives painful recollections, and the publication of which I should, for obvious reasons, have preferred to be left over until after my death It concerns a distinguished personality whose memory is cherished by many friends, but their ranks are now rapidly thinning, and for this reason I feel compelled to disregard personal considerations.

Early on during the War, I was one morning surprised to find paragraphs in the daily press implying that a wireless apparatus had been found and "seized" in my house, with more or less veiled references to the purpose for which the apparatus was likely to have been erected The complete story may be told some day, at present it is sufficient to say that I do not blame the newspapers

Though I knew that the implied accusation was not likely to impress my friends, the matter, in view of my position at the time, was serious, and it was with fear and trembling that I entered the Athenæum a few days later and selected a solitary place in the coffee-room. I was leaving again directly after luncheon, and as I was putting on my coat in the hall I suddenly felt some one stepping up behind to help me Surprised at this politeness, which is somewhat unusual in the Club, I turned round and looked into the kindly face of Lord Roberts, with whom I had no personal acquaintance The hall was then full of members of the Club, and it was obvious that the action was intended to be, and in fact was, a demonstration Such incidents are not likely to be forgotten

Obituary.

PROF W A HASWELL, F R S.

THROUGH the death of Prof W A Haswell, at the age of seventy-one, zoology has lost one of its foremost exponents, and the University of Sydney a teacher and investigator of world-wide reputation

William Aitcheson Haswell was born in Edinburgh in 1854, and was educated at the Edinburgh Institution and the University, where he gained the Bell-Baxter Scholarship as the most distinguished natural science graduate of his year As quite a young man he went out to Australia and, settling down in Sydney, there spent the rest of his life In 1880 he held the post of curator of the Queensland Museum Then, returning to Sydney, he delivered public lectures on zoology, and became in 1882 acting curator of the Australian Museum, and published his valuable Catalogue of the Australian sessile- and stalk-eyed Crustacea In the same year he was appointed lecturer in zoology and comparative anatomy in the University of Sydney, under Prof W J Stephens, who at that time held the chair of natural history Young and enthusiastic, Haswell threw himself with great energy into the study of the rich fauna of Port Jackson and the adjacent coasts, and in the course of a few years published, in the Proceedings of the Linnean Society of New South Wales, numerous papers, mainly of a systematic character, on the Crustacea, Annelida, and Bryozoa of the Australian seas In particular we owe to Haswell the first description, in 1882, of the giant Phoronis that occurs in Port Jackson, which he named *Ph australis*, and in the same year he exhibited drawings of the early stages of its development before the Linnean Society

During this period, however, Haswell by no means confined himself to invertebrate zoology, but contributed to the Linnean Society valuable papers on vertebrate morphology, on such diverse subjects as the anatomy of birds, the structure of the paired fins of Ceratodus, the skeleton of elasmobranch fishes, and the early stages of the development of the emu (1887). He also described in 1886 in the *Q J M S* the remarkable striate muscle fibres in the "gizzard" of the polychæte worm Syllis, and in 1889 published a very interesting comparative study of the same fibres In 1888, also in the *Q J M S*, he gave the first detailed account of the anatomy of that remarkable ectoparasitic trematode, Temnocephala, a form which will always be associated with his name

Such was the reputation Haswell had established for himself as an original investigator and teacher that the Senate of the University of Sydney, when the

Challis professorship of biology was instituted in 1889, appointed him to the chair, without advertisement—at the time a most unusual proceeding—and this he held continuously until his retirement in 1917 All through these years his scientific activity continued unabated

In 1893 Haswell published, in the Macleay Memorial Volume, his great monograph on the Temnocephaleæ, a group which occupied his attention right up to the end of his working days, for the last paper he wrote is entitled "Critical Notes on the Temnocephaloidea," and was published in the Proc Linn Soc N S W so recently as December 29, 1924 In the volume above mentioned he also described the remarkable new type, Actinodactylella, from the gill-cavities of the Gippsland burrowing crayfish, *Engæus fossor* In numerous papers, published mainly in the *Q J M S* and the Proc. Linn Soc. N S W, he contributed largely to our knowledge of the Turbellaria, both fresh-water and marine, and the Cestoda, and by his discovery of the histriobdellid, Stratiodrilus, and his detailed accounts of its anatomy and development, he greatly extended our knowledge of the "Archi-annelida," whilst to him we are indebted for the only available account of the early development of the Port Jackson shark (Heterodontus)

Outside the ranks of professional zoologists, Haswell is perhaps best known to the scientific world as the joint-author, with his staunch friend the late Prof T Jeffrey Parker, of the monumental "Text-book of Zoology," which, issued in 1898, is now in its second edition and is accepted as a standard text-book in zoological laboratories all over the English-speaking world

Amidst all his academic work Haswell found time to take an active interest in the various Australian scientific organisations. He was for long on the Council of the Linnean Society of N S W, and acted as its president in 1892–93, he was president of Section D of the Australasian Association for the Advancement of Science in 1891, and he was for many years a trustee of the Australian Museum In 1916 he edited the Reports of the Australasian Antarctic Expedition

Haswell was a man of wide knowledge and culture Shy and somewhat reserved in disposition, he was a loyal, warm-hearted, and ever helpful friend and a kindly and charming host He was a keen trout-fisher, enjoyed a game of golf, and was an ardent gardener In 1894 he married Josephine Gorden Rich, a pupil of Jeffrey Parker and joint-author with him of a paper on the myology of Palinurus, and she always took a lively interest in her husband's work. She and an only daughter survive him

Haswell was elected a fellow of the Royal Society in 1897, and was a member of numerous societies both at home and abroad

The writer will ever bear his old chief in grateful memory for the forbearance and many kindnesses he showed him during an association of some fourteen years.

J P H.

PROF JOHN CLELAND, F.R.S.

PROF JOHN CLELAND, who died on March 5, in his ninetieth year, held the chair of anatomy in Queen's College, Galway, from 1863 until 1877 In the latter year he succeeded Dr Allen Thomson as occupant of the chair of anatomy in the University of Glasgow, which he held until 1909, retiring at the age of seventy-four to spend the happy evening of his days at Crewkerne, Somerset

Cleland was a man of imposing appearance who impressed on the generations of students who passed through his class-rooms his love of knowledge, his wide culture, and independence of outlook He was beloved by his students All his life long he was fighting a rear-guard action He was born and bred in pre-Darwinian days and grew up in the school represented by John Goodsir and Richard Owen He believed in evolution—particularly the brand represented in the "Vestiges of Creation" He could not abide the dogmatic assurance with which Huxley proceeded to sweep the "underlying element of spirit" from all biological processes For him Darwin's law of "Natural Selection" was true and potent, but in his opinion this law was powerless in the production of purposive adaptations He was a student of "morphological design" and believed that a "unity of cause" worked through "the ordered sequence to be seen in all biological events" The "morphological beauty of the skull" was almost one of his religious tenets Those who know the researches and writings of John Goodsir will realise how strong was the influence which the master exerted on John Cleland seventy years ago With him goes the last representative of the transcendental and philosophical anatomists of the nineteenth century

Cleland was born in Perth in 1835, the son of a medical man He was turned from the Church to medicine by his mother, and began his studies in the University of Edinburgh in 1852 Goodsir, then a man of thirty-eight, was at the height of his fame and immersed in researches of the most diverse kinds, but was particularly enamoured of Owen's speculations regarding the "original design" which was supposed to underlie the head and body segments of vertebrate animals When Cleland became junior demonstrator to John Goodsir in 1857—Sir William Turner was then senior demonstrator—he applied himself chiefly to the morphological problems of the vertebræ and of the skull He published many dissections made on rarer animals, but the work he will be best remembered by is that done on the human skull Unfortunately, in 1857, Goodsir's great gifts were already being sapped by the disorder which carried him off ten years later; it is vain to speculate now as to the course events would have followed if Goodsir had retained his full powers of mind; his disease certainly fanned his tendency towards transcendentalism, and it was this side of his mind which had the strongest influence on his junior demonstrator

In 1861 Cleland left Edinburgh to demonstrate anatomy under Prof Allen Thomson of the University of Glasgow, one who was a master of scientific method. In 1863 he was appointed to his first chair, in Queen's College, Galway His best known research was done while he was there, and was published in the Philosophical Transactions (1870, vol 160, p 117), on "An Enquiry into the Variations of the Human Skull, particularly in the Antero-posterior Direction" This inquiry has not received the attention it deserves, for in

it Cleland directed attention to the remarkable changes in shape which the human skull passes through at various stages of growth of the child and at later phases of life. Even in adult years head form is not fixed; significant changes may occur in the later decades of life Between 1855 and 1906 he published more than fifty separate papers and covered a variety of subjects He was a poet and published a book of verse, "Scala Naturae" (1887); a volume of essays, "Evolution, Expression, and Sensation" (1881), he was one of the editors of the seventh edition of Quain's "Anatomy" (1867), with his former pupil, now Principal J Yule Mackay of University College, Dundee, he wrote a textbook on "Anatomy (Human Anatomy, General and Descriptive)," 1896, and a "Directory for the Dissection of the Human Body" (1877). A. K

DR A. DE WATTEVILLE.

DR. DE WATTEVILLE, whose death, at the age of seventy-eight, occurred in Switzerland on February 24 last, was a prominent member of the medical profession in London between twenty and thirty years ago A Swiss by birth, scion of one of the oldest families of Switzerland, he was an Englishman by education, and qualified for the medical profession He specialised in neurology, and more particularly in electro-therapeutics, which he did much to establish on a scientific basis His work on "Medical Electricity," which ran through two editions—the second in 1884—established his reputation as the chief authority on the subject in Great Britain He specially insisted on measurements of current strength as the essential condition of a rational application of electricity, and led to the milliampere being adopted as the electro-therapeutic unit by the International Congress of Electricians

It was, however, as editor of *Brain* that Dr de Watteville found his chief interest and occupation In 1883 he became associated as co-editor with the original founders and editors of this important journal—the late Sir J. C. Bucknill, Dr. Hughlings Jackson, Sir J Crichton-Browne, and Sir David Ferrier—and in 1886 was appointed sole editor, when *Brain* became the official journal of the newly founded Neurological Society This post he held until 1900 On his resignation the council of the Neurological Society by unanimous resolution paid him the following well-merited tribute:

The Council accepts with great regret Dr de Watteville's resignation of the Editorship of *Brain*, and desires to take this opportunity of recording the deep debt of gratitude that the Society owes him for the way in which he has conducted the Journal for the past twenty years The Council feels that parting with Dr de Watteville is an event of great moment to the Society, for he has not only brought *Brain* to a high standard of perfection and secured for it a great European reputation, but even the existence of the Journal at the present time is due to his energetic action at a critical juncture in 1880 Moreover, the Council is mindful that the Society itself took origin on Dr de Watteville's initiative at a meeting held at his house on November 14, 1885.

Soon after resigning the editorship of *Brain*, Dr. de Watteville left London and went to reside in Switzerland, and spent the remainder of his life in quiet study and contemplation among the beautiful surroundings of his native land Dr de Watteville was a man of wide culture and great force of character, charitable and self-sacrificing almost to a fault, and the outspoken foe of quackery and pretence of every description. D F.

WE regret to announce the following deaths

Dr W F Hillebrand, chief chemist of the U S Bureau of Standards, who was distinguished for his work on rock and mineral analysis, on February 7, aged seventy-one

Prof. A von Wassermann, emeritus professor of experimental therapy and immunology in the University of Berlin and director of the Kaiser Wilhelm Institute for Experimental Therapy in Berlin-Dahlem, on March 16, aged fifty-nine

Current Topics and Events.

ELSEWHERE in this issue is an article by Prof Raymond Dart dealing with certain evidence which, on his view, reveals a long history of cultural contact between South Africa and the outside world from an early date It is scarcely necessary to emphasise the importance of Prof Dart's views in relation to the "diffusionist" theories which have been put forward by Prof Elliot Smith and his colleagues Perhaps the most striking piece of evidence with which Prof Dart deals is the parallel drawn between the head-dress and clothing of certain figures in the Bushmen paintings of the Kei River Valley and of figures in the art of Babylonia and Western Asia Bushmen paintings are thought by some, for good reason, to be relatively modern, the evidence of the incrustation of which Prof Dart speaks is of little value without further information as to its character and rate of deposit If the identification of the Babylonian cap were accepted, it would suggest the eighth century B.C as a probable date, but without a strong corroborative evidence the identification is precarious, especially as this type of cap is of extreme rarity in Babylonian art Prof Dart is on surer ground when he points to the problem presented by the extensive traces of early mining activity in Rhodesia It may be that the researches of the Committee of the British Association which is investigating the composition of early bronzes may point to South Africa as one of the possible sources of supply and thus afford some clue to the date of some of these workings It is, however, beyond question that the discovery by Dr Randall-MacIver in the ruined structures of Rhodesia of Nankin china which could not be dated at the earliest much before the fourteenth century, is a great stumbling-block in the way of those who seek to prove an early date for the Zimbabwe culture

WITH the past two or three weeks reports have reached Great Britain of a new experiment carried

out by Prof Michelson and Dr Silberstein in the United States, on the principle of the Michelson-Morley experiment, to test the drift of the ether in relation to matter in motion No authenticated account of the experiment is yet available, but references have been made to it in letters from the United States, and the *Morning Post* of March 2 and 7 published articles stating that evidence of relative motion of ether had been obtained It is stated that a triangle of three water conduit pipes was used, and that the velocity of light travelling round the triangle was found to be different in two opposite directions Sir Oliver Lodge, in reply to an inquiry as to whether he had received any details of the experiment and the result, has been good enough to favour us with the following comments upon the subject · "In response to your inquiry, and judging solely from the newspaper accounts, the experiment mentioned as having been conducted by Prof Michelson and Dr Silberstein appears to be a repetition of the Fizean moving-water experiment, in which the water is this time kept stationary with respect to the earth, and only shares the earth's rotation If the rest of the apparatus did not share the earth's rotation, no one would doubt a perfectly calculable positive result The difficulty and interest arise from the obvious fact that the rest of the apparatus must have shared in the earth's rotation; so that an effect was (presumably) observed which did not involve relative motion of matter But, assuming all this true, the obvious way out is that 'rotation' has always been regarded as exceptional, and the observation, however interesting and important, need be no more perturbing than Newton's bucket or the shape of the earth"

AN important discovery by the Harvard-Boston Expedition to Egypt, which is working among the Giza pyramids, is announced According to a *communiqué* issued by the Egyptian Ministry of Public Works which appeared in the *Times* of March 10, a tomb has been found of which the burial chamber is at the bottom of a 150 ft shaft Although no detailed examination had then been possible owing to the unsafe condition of the shaft, a rectangular alabaster coffin was visible with a number of poles, the tops of which were covered with gold foil Among inscriptions on a plank by the side of the coffin was the cartouche of Seneferu, first king of the Fourth Dynasty, which would suggest that it is the burial-place of a member of his family The unusual depth of the shaft, however, and the fact that it is filled with concrete and cement instead of rubble as in other tombs in this area, have been taken to support the view that this is the tomb not merely of a personage of importance—a high official or a member of the Royal Family—but possibly of King Seneferu himself, although he is usually supposed to have been buried at Medum, where he built a pyramid Dr Reisner, however, who is in the United States, has cabled since the announcement of the discovery that the tomb is that of the Princess Medti-Seneferu Presumably he has definite evidence to this effect The floor of the tomb is covered by a quantity of objects, including alabaster bowls, a copper basin or ewer, and remains of heavily gilded chairs If it should appear eventually that this is the tomb of the King himself, it would constitute a discovery of great historical importance, but scarcely of less moment to the archæologist is the evidence which the tomb will afford in regard to the art and technique of the smaller objects mentioned, of which at this period little is known

THE sixth of Sir Oliver Lodge's series of "talks" on "Ether and Reality," broadcasted from the London station (2LO) of the British Broadcasting Company on Tuesday March 17, dealt with matter as one of the forms of energy Sir Oliver said that one of the functions of the ether is the constitution of matter itself Atoms are built of electrons and protons, and electrons are evidently composed of ether, because whatever mass they have is represented by the energy of their electric field, though we cannot yet, with any certainty, make a similar statement about a proton We know, however, that both are more massive when moving than when they are at rest Their mass and energy increase together, the extra mass behaving like additional matter, but not like permanent matter When an electron is stopped, the additional matter disappears it is changed into radiation and travels out as a quantum with the speed of light There is a curious kind of discontinuity in the immediate neighbourhood of a material nucleus the satellites can occupy certain positions and no others But they can drop from one of these positions to another, and they then emit energy in the form of radiation, which depends on how far they have dropped and where they drop to. The process is a reversible one, and when radiation is absorbed, the electron is jerked up again How far it is jerked up depends on the kind of radiation. The important thing is that matter is turning out to be one of the forms of energy This has been proved for temporary matter, and is probably true for permanent matter also, a conversion of which is believed to account for stellar radiation Whether the process is reciprocal—whether radiation can ever generate not only temporary matter but so-called permanent matter—still remains to be discovered

A SCHOOLBOY once replied to the question "What is an egg?" by stating that an egg is "an oval-shaped article of diet" The Concise Oxford Dictionary says that it is a "spheroidal body produced by female of birds, etc, especially of domestic fowl, containing germ of a new individual." Neither of these definitions can be regarded as entirely satisfactory from the scientific point of view, but the latter has the advantage of grasping to some extent the fundamental point and of restricting the application of the term to bodies of a similar nature A more precise definition is usually given by biologists of the Latin word "ovum," used as a technical term, an ovum, or egg-cell, is a nucleated cell capable of developing (usually after union with a spermatozoon) into a new individual, a conception, of course, that was as unfamiliar to Latin writers as it still is to dealers in eggs. An embryo, on the other hand, is an individual in an

early stage of its development from the ovum Unfortunately even men of science still use these terms in a very unscientific manner Human embryologists not infrequently apply the term "ovum" to quite advanced embryos, thus counteracting the efforts of those biologists who wish to emphasise the fundamental fact that every typical animal starts life as a single nucleated cell—to which alone the term "ovum" should be applied

IN their interesting and beautifully illustrated paper on "The Early Development of the Cat" (*Quarterly Journal of Microscopical Science*, vol 68, Part IV), Prof J P Hill and Dr. Margaret Tribe use the word "egg" in much the same way, but what justification can there be for this usage? It fulfils the requirements neither of popular language nor of scientific terminology. It is perhaps less objectionable than the illegitimate use of the word "ovum," which is evidently intended as a technical term and therefore ought to be used only with scientific precision But in what possible sense of the word are these early embryos of the cat eggs? They are not articles of diet, and they are in no way comparable to the egg of a fowl, but only to something which may, in certain circumstances, be found in the egg of a fowl We call this something an embryo—why should not the same term be used for the early stages in the development of the cat? It is in no mere carping spirit that we venture to make these criticisms, but with the view of directing attention to the necessity for a more rational system of terminology in embryological writings, and nothing that we have said must be regarded as indicating any want of appreciation of a most careful and accurate piece of work, a notable contribution to embryological science.

A TIDE predictor has been presented to the Tidal Institute at Liverpool and has been installed at Bidston Observatory The machine has 10 semi-diurnal components, 6 diurnal, 3 third-diurnal, 4 quarter-diurnal, and 3 sixth-diurnal components, 26 in all, provision has been made for the addition of other components, if desired Long-period components have been omitted, as such constituents are easily allowed for, if of importance. Very great care has been given to matters of design and workmanship, and the machine has been constructed in an admirably efficient manner by Messrs Kelvin, Bottomley and Baird, of Glasgow The accuracy of performance of the machine is very great, and it is capable of being used even for research work A noteworthy feature of the machine is the provision of apparatus for recording electrically the time at which the tide reaches a definite height The electrical contact is made by a roller on the edge of a wheel, which is attached by a flexible wire to the pen, and the electrical circuit is completed through a dotting apparatus which registers on a revolving drum The dots are arranged on a spiral line This chronograph can be used for registering the exact time of high (or low) water by setting on the machine the desired harmonic constants representing the rate of rise and fall of tide. The donors of the machine are Messrs Alfred Holt, the Booth, Cunard and Orient S S Cos, Mr. Harrison Hughes, Mr C Livingston, and the Local Committee for the Liverpool meeting (1923) of the British Association

THE *Welsh Journal of Agriculture*, of which the first number has recently been issued, is intended to fill a definite need by providing a channel whereby farmers and others in the Principality can be kept informed of the progress of agricultural education and research in Wales The published articles are to be based on scientific investigations, and will convey scientific and technical information set out in plain language to render it of the greatest possible value to the agricultural community The first number appropriately leads off with an outline of the history of agriculture in Wales, by C Bryner Jones, followed by an article on the human side of the farming business by A W Ashby Other articles of a general character, but all having a bearing on agricultural development, are given, dealing with genetics and the stock breeder, modern tendencies in soil research, and with various aspects of research in such fundamental matters as animal breeding, dairying, horticulture, and fruit culture The rest of the volume is occupied by a number of short papers on various Welsh investigations and by an important article by Prof Stapledon on "Seeds Mixtures for Temporary Grass" This outlines the results of investigations carried out in Denmark and Sweden in comparison with observations on similar trials now in progress at Aberystwyth, and is of much value as a contribution to the perennial problem which confronts the farmer who desires to put down leys of long or short duration A useful list of recently published agricultural books is included, together with a section of abstracts, reviews, and bibliographical notes

SIR E JOHN RUSSELL, Director of the Rothamsted Experimental Station, Harpenden, Herts, has been elected a corresponding member of the Paris Academy of Sciences, in the Section of Rural Economy, in succession to Prof Winogradsky, who has been elected a foreign associate.

THE Summer Time Bill was read a second time in the House of Commons on March 13 By it the dates between which legal or clock time is to be one hour in advance of Greenwich Mean Time are from the Sunday following the first Saturday in April to the Sunday following the first Saturday in October If the measure is passed, summer time will begin this year on April 5 and end on October 4 The period during which legal time is thus to be advanced has been decided upon in agreement with France and Belgium, and is to be the same every year instead of being determined year by year, as has been the case since summer time was first introduced in 1916

ON Tuesday next, March 24, at 5 15, Prof A S Eddington will begin a course of two lectures at the Royal Institution on the internal constitution of the stars; on Thursday, March 26, at the same hour, Mr T Thorne Baker will deliver the first of two lectures on the chemical and physical effects of light;

(i) "Reproduction of Light Images by Photography," (ii) "Transmission of Light Images by Electricity", and on Saturday, March 28, at 3 o'clock, Prof J H Ashworth commences a course of two lectures on the nervous system and some reactions The Friday evening discourse on March 27 will be delivered by Sir Ernest Rutherford on "Studies of Atomic Nuclei," and on April 3 by Sir Daniel Hall on "The Productivity of English Land"

THREE research assistants are required at the Building Research Station of the Department of Scientific and Industrial Research Candidates must be honours graduates in chemistry or have an equivalent qualification, with some experience in research One post requires a special theoretical knowledge of paints and varnishes, another of physical chemistry, and another of inorganic chemistry, a good knowledge of metallography, and ability to read French and German Applications, upon a special form, must be received by, at latest, March 28 by the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1

AT the annual general meeting of the Ray Society on March 12, the following officers were re-elected *President*, Prof. W C M'Intosh, *Treasurer*, Sir Sidney F Harmer, *Secretary*, Dr W T Calman Lord Rothschild was elected a vice-president, and Prof A E Boycott and Mr R T Gunther were elected new members of council It was announced that the first volume of "British Hydracarina," by Mr C D Soar and Mr W Williamson, would shortly be published, and that the issue for 1925 would be the "Life of Wilhelm Hofmeister," by K v Goebel, translated by Prof F O Bower The Society published in 1862 a translation of Hofmeister's work on "The Higher Cryptogamia," and it seems fitting that the life of the author should now be included in the same series The Council has also undertaken to publish a monograph on "British Sea Anemones," by Mr T A Stephenson, which will be illustrated with coloured plates from drawings by the author It is intended that the first volume shall form the issue for 1927

WE learn from *Science* that it has been decided to establish a National Hall of Fame for Engineers, Inventors, and Industrialists in the proposed National Museum of Engineering and Industry to be erected in Washington Records of the achievements of the outstanding leaders in invention and engineering, now scattered throughout the country, are to be assembled, and all original models, so far as recoverable, are to be obtained for the museum In addition to the central museum, it is hoped to form a chain of local museums of industry in the industrial centres of the country Among those who probably will be represented in marble or in bronze in the Hall of Fame will be Charles P Steinmetz, Alexander Graham Bell, Thomas A Edison, Orville and Wilbur Wright, Eli Whitney, Captain John Erikson, Mergenthaler, and Robert Fulton.

THE report of the Department of Agriculture of the Tanganyika Territory for the year ending March 31, 1924, gives an account of attempts to improve and extend crop production in that region of Africa Among the most important features of these experiments was the introduction of ploughing among native cultivators The sub-district of Shinyanga was selected for the experiment as having certain advantages in a closely settled population and extensive areas of cultivable soil in open country free from the tsetse fly The attempt was facilitated by the growing interest of the natives in cotton production, while the tribal organisation lent itself readily to a system of cultivation by communities A station for the training of oxen was established, where the natives were instructed in ploughing Twenty-five ploughs were then issued to native villages, with the result that 500 acres of land were put under cotton, and requests have been made for a supply of 320 additional ploughs for use during next cotton season A further development of the work which is even more striking consists in the extension of ploughing into areas at present covered by bush and infested by tsetse fly This not merely increases the area available for cultivation but also causes the recession of the fly-stricken bush, which was advancing into open country and restricting cattle-grazing grounds

THE Botanical Society and Exchange Club of the British Isles issues with its report for 1923 a plate illustrating the little sedge *Carex microglochin* Wahl, the discovery of which at Glen Lyon, Perthshire, by Lady Davy and Miss Gertrude Bacon, is described by Dr. G Claridge Druce, the secretary of the Club, as the great botanical event of the year In addition to the usual notes upon rare finds during the year, or references to interesting work upon British species and new county records, the report contains several papers of distinct interest to systematists, such as the paper upon British forms of Thymus by K Ronniger, Vienna, notes on British mints by J Fraser, on violets by E S Gregory, upon *Orchis maculata* L and *O Fuchsii* Druce, by G Claridge Druce Descriptive accounts of special areas of vegetation include that upon the vegetation of Beinn Laoigh (Perthshire) by Donald Patton, and of the Culbin Sands by E J A Stewart and Donald Patton The report closes with a very interesting illustrated account of the foundation of the Oxford Botanic Garden and its tercentenary by Dr Druce. No one is better qualified than this writer to evoke in a few brief pages memories of the many botanists officially connected with this historic botanic garden

IN his article on "Early Activities of the Royal Society," in NATURE of January 31, Mr T E James referred to the election of Pepys and his undertaking in 1674/5 to provide a lecture for the Society Mr James was unable to find any record of Pepys having kept the promise or paid the fine in default, and he remarked that there was "no reference to this lapse in the well-known Diary" Mr C Macnamara writes from Arnprior, Ontario, to point out that the last date in the Diary is May 31, 1669, that is, several years before Pepys made the promise mentioned in the article

THE efficient equipment of observatories calls for the services of the engineer as well as the scientific-instrument maker and the optician The firm of Messrs Cooke, Troughton and Simms, Ltd, Buckingham Works, York, are fortunate in having at their command facilities for the production of all the apparatus and equipment required for astronomical observation. Several well-known observatories have been built and equipped by the firm, and this branch of their production is now being further developed A recently issued catalogue, No 570, contains a full list of astronomical instruments and apparatus manufactured by them, including domes from 10 to 40 feet in diameter, telescopes with objectives up to 20 inches in aperature, a full range of eyepieces, photographic and spectroscopic accessories and position micrometers. Portable equatorial and alt-azimuth stands, semi-portable and fixed equatorial telescope mountings and transit instruments, of various types, are described and illustrated, as well as mechanical and electrical accessories The articles included in the catalogue are all standard apparatus and instruments, for which prices are quoted, but the firm undertakes also the design and construction of instruments for special purposes

Two important catalogues of second-hand books of science have just been issued by Messrs Wheldon and Wesley, Ltd, 2 Arthur Street, W C 2, viz No 15, Zoology, Part 2—Vertebrate Faunas, containing nearly 1500 titles, and No 16, Lepidoptera, with some 262 titles A number of scarce works are offered for sale, and the catalogues should appeal to many readers of NATURE

Our Astronomical Column.

MIRA CETI—There have been three interesting discoveries made concerning this famous variable in recent months The finding of the faint companion, that is responsible for the bright lines seen in the spectrum at minimum, has already been reported in this column The next step was the investigation of its heat radiation by the thermocouple by Messrs Nicholson and Pettit at Mt Wilson, this was described by Prof Eddington at the February meeting of the Royal Astronomical Society (see *Observatory* for March, p 58) While the visual magnitude varies from the third to the ninth, a 200-fold range, the "heat magnitude" varies only from 1·5 mag to 3 mag, a 4-fold range This shows that the loss of light is almost wholly in the short wave-lengths

The third discovery, reported in the *Times* of March 12, is that Dr F Pease has successfully applied the 20-ft interferometer on the 100-inch reflector at Mt Wilson to the measurement of the angular diameter of Mira, obtaining the value of 0·06″, which is the largest yet found for any star, though its linear diameter would be about equal to that of Betelgeuse, each being about 250 million miles, assuming that their adopted parallaxes are correct

It is evident that the surface brightness of Mira must be very low, since in spite of its greater angular diameter it is some two magnitudes fainter than Betelgeuse even when at its maximum light It will probably be followed for as long a portion of the light curve as the interferometer method permits, in order to see whether the diameter varies periodically Such a variation was strongly suspected in the case of Betelgeuse, itself a variable but with a much smaller range

Mira is probably the nearest to us of the long-period variables, and anything found about it may be applicable to the whole class They were formerly thought to be expiring suns, but are now considered to be at an early stage of star-life

A NEW APPLICATION OF THE SPECTROHELIOGRAPH—Mr Royds, Director of the Kodaikanal Observatory, described at the meeting on March 13 of the Royal Astronomical Society, a new method of using this instrument Instead of placing the second slit wholly on the H_α line of hydrogen, it was made to project on to the light spectrum, the character of the image was then found to be entirely different. Instead of measuring the amount of light from glowing hydrogen in different regions, it now measures the varying pressure of the gas by the varying width of the line, and consequent reduction of light where it is broadest and the pressure greatest

Each sunspot is found to be surrounded by a narrow bright ring, outside this there is a large dusky region, showing a good deal of structure The general mottling of the whole disc is very clearly brought out, and seems to have more regularity than in ordinary pictures The method is quite a hopeful one for bringing out some new points concerning the distribution of gases over the sun's surface

THE SYSTEM OF β-LYRÆ—Prof H H Turner, at the meeting on March 13 of the Royal Astronomical Society, announced an interesting result which Miss Blagg has obtained She finds that there is a small subsidiary variation of light, the amplitude of which is about 0 1 magnitude, and period 6 595 days, very little in excess of the 6 454 days which is the half period of the main variation It is this approach to synchronism that has prevented the new term from being detected earlier It shows itself not as a separate curve, but as a slow alteration in the amplitude of the principal curve No suggestion was made of the explanation of this new term As the two stars are supposed to be almost in contact, there would not seem to be room for a third orb in their immediate vicinity

THE DISTANCE OF THE ANDROMEDA NEBULA—Prof H N Russell gives some further details in *Scientific American* for March of Prof Hubble's investigation of the distance of this nebula by photographing the Cepheid variables in it He mentions the possibility that was alluded to in NATURE of March 7, p 349, that absorption by the nebula might diminish the stars' light and so give too large an apparent distance. But he says that several stars in different parts of the nebula agreed in giving the same distance, thus showing that the absorption effect must be very small, since otherwise it could scarcely be the same for all the stars Prof Russell also notes that stars that are individually visible in the nebula must be a thousand times as luminous as the sun, hence only the extreme giants are separately visible, and the great mass of the stars in it are only seen as a general glow There is still something of a puzzle about the very rapid diminution of light as we pass away from the centre that was found by Mr Reynolds's photometric measurements This seems to indicate a different structure from that in our sidereal system.

Research Items.

PALÆOLITHIC MAN IN CENTRAL EUROPE —L'Abbé Breuil continues his account of his "voyage paléolithique" in Central Europe in *L'Anthropologie*, t 34, No 6 He now deals with finds in the loess of Moravia and Bohemia, which are to be described in two sections, the first, which is the present instalment, covering open-air shelters, and the second the caves Three stations in Moravia are described Premost, Ondraditz, and Brno (Brunn) As regards the human remains found at Premost, L'Abbé Breuil is of the opinion that the view of Dr Hrdlička and Dr Matiegka, that Premost man represents a cross between Neanderthal man and the Aurignacian races, cannot be maintained The prominent supraorbital ridges cannot be regarded as a decisive criterion against the absence of characters such as the remarkable platycephaly, the development and specialised character of the face, of the nose and orbits, and the receding chin of Neanderthal man—characters which are far more significant than the prominence of the supraorbital ridges The same applies to the Brno man. Both must be regarded as Aurignacian, differing from Aurignacian man in Western Europe, it is true, but also exemplifying the highly diversified character of the Cro-Magnon race, which was probably already a mixed race when it penetrated Europe

ANTHROPOLOGY OF THE CHINESE —Mr W W Cadbury, of the Canton Christian College, contributes to the *Philippine Journal of Science* for December a study of the height, weight, and chest measurements of Mongolian peoples, with special reference to the Southern Chinese He has made a valuable digest of the literature dealing with these points and has added to it the results of his own observations on the students of the Canton Christian College The general conclusions at which he arrives are that the Chinese people average 165 cm in height, the people south of the Yangtze being generally taller than those to the north of the river Cantonese students of 20 years or more average 163 6 cm The average weight for the Chinese is 56 9 kgm in the north, 52 6 kgm in the south, Cantonese students 51 9 kgm The weight-for-height index varies from 313 in the south to 384 in soldiers of the north Cantonese students average 317 Chest circumference is relatively small, varying from 77 4 to 86 9 cm Cantonese students have an average circumference during rest of 78 9 cm with a play of about 6 cm

CANCER AND GOITRE —In a recent number of *Biometrika* (vol 16, 1924, p 364), Dr Percy Stocks concludes, from a statistical examination of the data of several countries, that there is a distinct positive correlation between the rate of mortality from cancer of the stomach and œsophagus and indices of the prevalence of goitre An analysis of post-mortem records also leads to the conclusion that enlargements and other anomalies of the thyroid, the anomalies being usually of the type associated with depressed functioning, are more frequent in cases of cancer than in other cases On the other hand, there is some evidence of a negative correlation between the incidence of cancer and of Graves' disease Dr Stocks thinks that these findings "seem to indicate that defective functioning of the thyroid gland is favourable to the incidence of cancer of the stomach, and possibly of other organs also"

SOUND PRODUCTION BY INSECTS —An interesting critical paper on this subject by Mr Frank E Lutz is to be found in the Bulletin of the American Museum of Natural History, vol 50, 1924, pp 333-372, and the conclusions arrived at by this observer may be briefly mentioned He remarks that, leaving out of account the Orthoptera and the cicadas, there are few or none of the sound-making insects that have well-authenticated organs of hearing, or the sound-producing organs of which may not quite conceivably produce the sounds by pure accident and without any purpose or profit Until we have proof that insects in general purposely make sounds, or that they profit by sounds which they make without intention, there is nothing in our present knowledge of the biology of insects that furnishes good ground for believing that the few cases in which we hear insect-sounds are really exceptions to a rule that insects do not communicate by that means In the cases of Orthoptera and cicadas, the presence of extreme specialisations, wonderfully efficient in producing sound and apparently not used for any other purpose, gives us a reason for thinking that there is a purpose The presence of what seems to be a definite ear in the stridulating Orthoptera is an additional reason However, when we see that the termites, which are not known to stridulate, have the same sort of an ear as crickets and long-horned grasshoppers, and that the cicadas, which produce a loud (to us) sound, probably have no ear (unless it be connected in a deafening way with the sound-producing structure), this latter reason loses some of its force. If these structures have not arisen for the purpose of making sounds, why have they arisen, and how? There is at present no certain answer to this question In a former paper (Lutz, Annals N Y Academy of Sciences, 39, pp 181-282) an attempt was made to show that complicated and definite structures, including details of wing-venation, had arisen by mutation or through the action of developmental factors without any "purpose" or favouring action of natural selection. The author does not say that this is true of the cricket's wing and the cicada's drum, but he does not deny the possibility

CHROMOSOMES OF *PARIS QUADRIFOLIA* —Mr. Bolles Lee contributes another paper (*Quart Journ. Micro. Sci*, vol 69, part 1) on the structure and division of chromosomes In a study of *Paris quadrifolia*, he finds that the chromosomes contain a spiral periaxial filament and are surrounded by a sheath Various observers have described such a spiral, others have interpreted it as a row of alveoli. The small sizes of these structures renders their interpretation one of great difficulty The most surprising conclusion drawn is that the chromosomes always divide transversely in the telophase of mitosis, and never longitudinally at all We can only say that much more convincing evidence would be required before such a view could be regarded as at all probable Practically all of these results have been controverted by Martens (*C R Paris Acad Sci* t 179, p 1280) in a preliminary paper in which it is also claimed that a reticulum of delicate threads can be demonstrated in the living "resting" nucleus and is therefore not created by fixation methods

SOME NEW GREGARINES —B. L Bhatia and S Setna (*Parasitology*, vol 16, p 279, 1924) record the occurrence of a cephaline gregarine, probably a species of Leidyana, in the alimentary canal of a carpenter bee, *Xylocopa æstuans*—the first gregarine to be described from a hymenopteran host The parasite occurs in large numbers throughout the length of the alimentary canal in every carpenter bee examined, but although the investigation extended

over several months, neither cysts nor spores were met with The authors suggest that these stages probably occur within the larvæ of Xylocopa They also record the occurrence of a species of Leidyana in the parenchyma of the polyclad Leptoplana

COPEPODA OF THE CHILKA LAKE —Major R B. Seymour Sewell records (Mem Ind Mus, vol 5, pp 771-851, 16 plates, 1924) the results of his examination of the copepod Crustacea of the Chilka Lake Of the fifty-seven species present in the collection twelve are regarded as new, and five new varieties are also described The author gives an account of the changes in the copepod fauna correlated with the varying conditions of the water, *e g* the influx of sea-water during the winter months causes a disappearance of the purely fresh-water species which had been carried into the lake during the monsoon He remarks upon the number of species, hitherto regarded as being typical inhabitants of north temperate or even arctic seas, present in tropical waters The breeding seasons of many of the species are noted

HYDRA CHIMÆRAS —Mr V Issayer describes an extended series of experiments (*Journ Genetics*, vol 14, No 3) in producing animal chimæras by grafting together in various ways two species of Hydra, a stalked form of brown colour (*Pelmatohydra oligactis*) and a red variety of *Hydra vulgaris* found near Leningrad the cells of which contain carotinoid and lycopinoid pigments The former species also has longer tentacles By pinning together two specimens which had been opened out flat, by inserting an individual of one species into the cavity of another, and by other methods, chimæras were obtained the components of which could be followed by their colour. Mosaics were also obtained by cutting up Hydras into fine pieces and moulding the fragments together Parts of some chimæras were intermediate in character and were called cytomictical (It may be pointed out that the term cytomyxis is already in use in cytology in another sense) Such individuals frequently reverted in buds to *oligactis* but never to *vulgaris* The bearing of these results on problems of individuality, divisibility, regulation, somatic mutation, and other topics is discussed A cytological study of these forms is being made which will throw more light on their nature

SOUTH AMERICAN FUNGI —Under the title "Fungi Paraguayenses," Carlos Spegazzini describes in the Anales del Museo Nacional de Historia Natural de Buenos Aires, vol 31, some 267 species and forms of fungi collected by him during a visit to Asuncion in 1920. Many new species are described and figured, spore sizes and figure as well as other microscopic data being supplied

POISONOUS PLANTS AND LIVE-STOCK —In the *Kew Bulletin* (No 1, 1925), J Burtt Davy has an interesting note underlining the value of scientific investigation of the causes of losses to live-stock as the result of local peculiarities in the quality of the grazing grounds He uses as a text the important reports upon "Gauwziekte Veld," by Sir Arnold Theiler and Dr. Pole Evans, which have recently been published by the Department of Agriculture, South Africa The nature of the injury to stock thus produced may be estimated by the fact that one farmer lost 1047 sheep (59 per cent of his flock) after grazing them for less than twenty-four hours on gauwziekte veld After prolonged inquiries lasting over ten years and feeding tests with 98 species of plants, these investigators definitely proved that the cause of the losses of stock was *Vangueria pygmæa* (Rubiaceæ) This plant appears to contain a toxic principle, acting directly on the heart, though the toxin has not yet been isolated Other cases of toxic species in grazing grounds are referred to by the author, who is thus able to make out a strong case for the work of a Government Department of Agriculture by which alone long and extensive investigations, involving the co-ordination of the work of specialists in different fields, can be both promoted and maintained until success is reached

SYMBIOSIS OF SEEDS AND BACTERIA.—Gilbert J Fowler and Miss R K Christie raise this question on very general lines in their paper in the Journal of the Indian Institute of Science, vol 7, part xiii They say that every seed they have examined so far has proved to be associated with specific bacteria either within the seed (poppy), within the husk (rice) attached to the seed by the mucilage coat (*Cassia tora*), or on the testa (indigo-seed) These bacteria are not essential to the germination, but do appear to be helpful in the growth of the seedling Little difficulty appears to be raised by the authors' conclusion that these bacteria can break down protein reserves, but it is not clear how this property could be utilised by the germinating seedling An interesting point is raised by the suggestion that the growth of these bacteria is associated with the specific seed extractive, apparently of basic or glucosidic nature, and removable by water or other suitable solvent, which every seed examined appeared to contain This extractive did not prove on examination to be invariably antiseptic, but it is suggested that, on dilution during germination, it may stimulate the growth of the bacteria associated with the seed whilst holding them in check so long as it is concentrated, as in the resting seed

CLIMATIC CONDITIONS FOR COTTON GROWING — Mr E E Canney has carried out a useful piece of work in analysing the climatic conditions required for the growth of cotton without irrigation (Journal of the Textile Institute, vol 15, p 1533) He finds that three conditions are essential · freedom from frost during the growing season, adequate but not excessive rainfall, and abundant sunshine The cloudy, humid climate of large areas of the tropics is fatal to the economic production of cotton of good quality The mean annual temperature should be above 60° F, the rainfall between 20 and 60 inches per annum, and the mean cloudiness less than five-tenths On this basis he has prepared maps showing the areas where climatic conditions are favourable for cotton growing, and he finds that there are large parts of the British Empire, awaiting development, with suitable climates for growing as much cotton as is likely to be required for a long time In the text, and still more strongly in an accompanying letter, Mr Canney points out the urgent need for trustworthy meteorological observations from many more stations than at present exist in tropical regions The lack of information as to climate retards development, and may lead to expensive failures owing to attempts to grow crops in regions which are climatically unsuitable

ATOMIC WEIGHT OF BROMINE —The January number of the Journal of the Chemical Society contains a paper by H V A Briscoe and P L Robinson on the atomic weight of bromine. Ammonium bromide was subjected to 2700 fractional crystallisations from water, the object being to test Richards and Hall's conclusion that isotopes are inseparable by fractional crystallisation. No evidence of separation

was obtained. From the ratio Ag/AgBr, the atomic weight of bromine was found to be 79.914 ± 0.01.

CHLOROPHYLL SPECTRA.—Jan Wlodek has an ingenious suggestion to account for the differences observed between the spectra of chlorophyll in the living leaf and in various solvents. By combining the absorption spectra given by Willstatter and Stoll for chlorophylls *a* and *b*, he obtains a spectrum with absorption bands very closely coinciding with those of the living leaf, far more so than does the absorption spectrum of the alcoholic solution of the mixed pigments. He suggests therefore that in the living leaf the two chlorophylls are present in separate solvents, and that the changes in the absorption spectrum of the leaf under insolation are due either to the proportion of the two pigments changing, a fact that Willstatter and Stoll failed to establish by their classical analyses of the pigments, or that new spectra are developed as the result of temporary combination with carbon dioxide. The paper is published in English in the Bulletin de l'Académie Polonaise des Sciences et des Lettres, Séries B, Science Naturelles, pp. 407-423, 1924, as a contribution from the Jagellonian University of Cracow.

ABSORPTION OF RADIATION BY THE EMITTING ATOM.—In the *C.R. Acad. Sci. Paris* of January 19 M. de Broglie and J. Thibaut describe measurements of the intensities of the corpuscular lines, due to the conversion of the *K* radiation of tungsten (doublet α) in an element, and of the *K* fluorescence lines of the element itself. The relative intensity of the second, with respect to the first, increases regularly with the atomic number for copper, silver, iodine, and barium. Bragg's law, combined with that of Moseley, would indicate a variation in the opposite direction. In the case of radioactive transformations giving β- and γ-rays simultaneously, the β-ray spectrum being due to a photoelectric action of the γ-rays on the electronic shells of the disintegrating atoms, it is found that when the γ-radiation is converted into secondary photoelectrons in an isotope of the disintegrating substance, producing an identical β-spectrum, the intensities of the lines are much less than in the original spectrum of the radioactive substance. Using mesothorium and lead, the ratio of the intensities was found to be very roughly 1 : 10, indicating a much more intense absorption of mesothorium γ-rays in mesothorium than in lead. Ellis has come to a somewhat similar conclusion on this subject, though he considers that in a γ-radiator the γ-rays are absorbed most strongly in the actual atom from which they are emitted, a point to which the authors have not directly given attention in their paper.

THERMOPILES IN THE LARGE SCALE MANUFACTURE OF GASES.—In the manufacture of hydrogen by the electrolytic process, it is very important to know at every stage the percentage of oxygen in the gas, and highly desirable to have an arrangement for sounding an alarm signal when the proportion of this impurity becomes too large. Dr. P. Gmelin, in the F. Paschen *Festschrift* number (January) of the *Annalen der Physik*, describes apparatus in which a small quantity of the gas is passed constantly through pressure regulators, half of the stream being sent through a tube of hard glass containing eight alternate thermal junctions of copper and constantan, and half through a similar tube, parallel to the first, which contains the remaining junctions. The two tubes are surrounded by an electric furnace, and in one of them pure platinum is deposited in the neighbourhood of the thermal junctions, to act as a catalyser for the combustion $O_2 + 2H_2 = 2H_2O$, the heat of the reaction being given up to the junctions. When no oxygen is present the registering millivoltmeter, to which the thermopile is connected, is not affected, and when the amount of this gas reaches 2 per cent. the deflexion is sufficient to make an electric contact and ring an alarm bell. It is arranged that this bell shall also ring when the current through the electric furnace is too low and when the gas stream is interrupted. The apparatus can be adapted to show the presence of 0.1 to 2 per cent. of oxygen in nitrogen manufactured by the Linde process. Enough hydrogen is added to the test stream to combine with the oxygen and leave a small excess. Instead of the single pair of tubes described, as many as twenty-four pairs have been employed, to register from 0.01 to 0.5 per cent. of oxygen in mixtures of nitrogen and hydrogen.

THE PHYSICS OF SPRAY FLUIDS.—Rowland Marcus Woodman has two further papers upon this subject in the *Journal of Pomology*, vol. 4, No. 2, January 1925. In the first paper is studied the influence of various substances in maintaining a suspension of lead arsenate, that is, in preventing its sedimentation, and it is pointed out that this is by no means the same property as that of lowering the surface tension of the liquid air surface so that the spray fluid readily wets the surface of the plants upon which it is discharged. As the results of experiment, gelatine and calcium caseinate were found the most effective substances in promoting both these desirable ends; by fine grinding lead arsenate could be got into permanent suspension in water alone, but calcium caseinate, gelatine, or some other substance would still be necessary, in this case, to promote spreading. In the second paper the advantages of the method of intermittent shaking for the preparation of emulsions of oil in water are studied and elucidated. Gelatine and potash soaps prove to be much better emulsifiers than sodium soaps.

A NOVEL T-SQUARE.—A new T-square and drawing-board made by Axene Ltd., Maxwell House, Arundel Street, W.C., has been brought to our notice. The object of the invention is to "free the hands of" the draughtsman by providing a T-square which will retain its position on the board without any complication of cords or pulleys. This is accomplished by the use of a magnet as the stock of the square, running on a steel strip in the edge of the board. The principle is not new, and previous inventions on these lines have not come into general use. The distinction of this square lies in the utilisation of the new magnetic cobalt alloy said to retain its magnetism almost indefinitely, and the whole of the stock is composed of this alloy. An examination of one of these boards suggests that, provided the length of the stock be proportioned to the length of the T in a ratio not less than found in ordinary squares, the T-square retains its position unaided, and assuming the retention of its magnetic properties, should be of considerable value to draughtsmen. These T-squares can be made with movable heads, but the leverage on the fixing screw on a long square is so great that a fixed head is usually preferred, at least for work which is mostly rectangular, and we did not observe any notable improvement in this respect in the square under discussion. Another useful feature of "The Axene" is the bevelling of the under side of the back edge of the square, enabling it to slide over drawing-pins. The drawing-board can be made with a steel strip on the bottom as well as on the left-hand edge, enabling the T-square to be used vertically and set squares to be dispensed with for work in which this position of the T-square is more convenient.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Ernest Benn, Ltd—Practical Butter and Cheese Making, L J Lord, Market Nursery Work six books on the cultivation of crops for market, F J Fletcher, cheap edition, Sugar Beet from Field to Factory, R N Dowling *Constable and Co, Ltd*—The Science of Soils and Manures, J A Murray, new edition *H M S O*—Report of the Departmental Committee on the Outbreak of Foot-and-Mouth Disease, 1923–24 *J B Lippincott Company*—Agricultural Mechanics, R H Smith *University Tutorial Press, Ltd*—Farm Calculations and Accounts, Dr A G. Ruston, Farm Measurements (Mensuration), Dr. A G Ruston

Anthropology and Archæology.

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Biology.

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World Wheat Production

DURING the past ten years it has been realised that all the countries in the world have a common bond in the international trade in wheat Various adjustments in relationships have perforce been necessary, but the six years which have elapsed since the War have given wheat-growing countries time to stabilise their positions and in some degree to accommodate themselves, on one hand, to the cessation of export from Russia, and, on the other hand, to the discontinuance of the artificially enhanced production prevalent during the War years. For this reason the agricultural statistics for 1923 [1] published by the International Institute of Agriculture at Rome, with their comparisons with pre-War years, are of special interest, since they do at this stage indicate the trend which agriculture in general and wheat production in particular is taking throughout the world

The situation as revealed by the year-book is, on the whole, reassuring Except in Europe, both area and production in wheat show an increase over the corresponding figures for the period 1909–1913 In North America the increases in area and production are approximately 40 per cent The year 1923 was admittedly a favourable one for wheat growing, but an examination of the annual returns shows that this increase is not an isolated instance Europe is still 7 3 per cent below its pre-War average in production of wheat, and 9 5 per cent below its average area in that crop over the same period, but the area has increased steadily since 1920, and the production, notwithstanding fluctuations, has never fallen lower than it was then

Russia is omitted from these returns, but the decrease in wheat production in that country during 1922, when famine conditions were at their worst, is now authoritatively stated as fifty-five and a half million quarters, or 65 per cent of the pre-War average In 1923 Russia had a small export trade. It will be remembered that, before the War, Russia was one of the chief sources of the world's wheat supply

A good deal of attention has recently been directed towards the wheat production and crop balance-sheets of Canada and the United States No appreciable decrease in area under cultivation in either country is

[1] International Year-book of Agricultural Statistics for 1923 Rome. Imprimerie de l'Institut International d'Agriculture, pp xcv+471

recorded in the data published, but wheat production in both is less in 1923 than in 1922 Almost the whole of this loss can be apportioned to the United States, where increases in the more important crops of cotton and maize more than counterbalance it Four million acres went out of wheat in 1923 and 5 4 million were added to the maize and cotton crops Further, the excess of exports over imports of wheat has fallen from 32 million quarters in 1921 to 9 6 millions in 1923. Taken together, these figures would seem to afford a striking confirmation of the forecast made by the Bureau of Agricultural Economics in the U S Department of Agriculture Year-book for 1921 In a paper on "Wheat Production and Marketing," O E Baker says, "Wheat production, however, has been increasing less rapidly than population in this country, and it is very probable that this will continue to be true, at least until we reach the point where we consume practically all we produce" Such a state of affairs is obviously of very serious import

The International Year-book has grown during its brief career, and this issue gives many more details than its predecessors It is to be regretted that in so doing it has been thought necessary to discontinue some of the summary tables That relating to the percentage of each crop, based on total area under cultivation in each country, is a noticeable omission The book contains sections dealing with crops, livestock, trade returns, prices, freight charges, fertiliser consumption, and rates of exchange, and will repay perusal not only by the agriculturist and economist but also by the interested layman

Critical Ionisation Potentials.

THE publications in the Bulletin of the National Research Council of the Washington Academy of Sciences have included many numbers which are excellent reports on the state of knowledge at the time of publication in special branches of modern science The monograph under review [1] is stated to be the first of a series which, when complete, will form the report of the National Research Council Committee on Ionization Potentials and Related Subjects The monograph is in two parts, the first of which, by Prof K T Compton of Princeton University, deals with the methods by which critical potentials for the excitation and ionisation of atoms and molecules by electron impacts have been measured The author gives a very clear account of the principles of the various experimental methods of determining the critical potentials of gases and metallic vapours, and of investigating their significance There is also a brief section on the critical potentials for the production of soft X-rays from solids The text is well illustrated by diagrams of apparatus and experimental curves, which will be particularly appreciated by the general reader

The second part of the work deals with the interpretation to be placed on the critical potentials which have been measured, that is to say, it is a discussion of the nature of the particular disturbance produced within the atom or molecule at each critical stage It is written in a clear and concise manner by Dr F L Mohler, of the United States Bureau of Standards The relation between lower critical potentials and arc spectra is first given Multiple excitation phenomena and the higher critical potentials of gases are then dealt with, and the interpretation of the latter class of data is further considered in connexion with the results for soft X-rays from solids A final section deals with the results which have been obtained from experiments on polyatomic gases, and their relation to thermochemical data The whole is illustrated by clearly drawn energy diagrams and Moseley curves

The bibliography which is appended to the monograph is a very comprehensive one and will be of value to research workers in this field Altogether the book forms the most complete summarised account we have seen of the work which has been done in the important branch of modern physics with which it deals, and the authors are to be congratulated on their excellent production

[1] "Critical Potentials," by K T Compton and F L Mohler, Bulletin of the National Research Council, Vol 9, Part 1, No 48 Pp 135 (Washington, D C National Academy of Sciences, 1924) 1 60 dollars

University and Educational Intelligence

BRISTOL —A lecturer in physiology will shortly be appointed, with duties to begin on October 1 Particulars of the post may be obtained from the registrar The latest date for the receipt of applications for the lectureship is April 20

CAMBRIDGE —The Adams Prize for an essay on "The Physical State of Matter at High Temperature" has been awarded to Mr R H Fowler, Trinity College. A Smith's Prize has been awarded to T G Room, St. John's College, for an essay on "Varieties generated by Collinear Stars in Hyperspace" F C Phillips, Corpus Christi College, has been elected to the Amy Mary Preston Read Scholarship

The subject for the Adams Prize for 1925–6 is "The Constitution of the Interior of the Earth and the Propagation of Waves through the Interior and over the Surface of the Earth" The adjudicators say that "the facts as to the propagation of earthquake waves may now be considered fairly well established, and a discussion is asked as to the deductions which can properly be drawn as to the constitution of the interior of the earth Such questions may suitably be treated as the reflection, refraction and dissipation of waves at surfaces of discontinuity, if any, inside the earth, also the interior arrangements which would best account for the ordinary P, S seismological tables A discussion might also be given as to how far the various suspected periodicities of earthquake phenomena, if real, must be attributed to a periodicity of external agents, and how far, if at all, they represent periodicities of free vibrations of the earth itself" The Prize, which is of the value of 240*l*, is open to competition of all persons who have at any time been admitted to a degree in the University

Grants have been made from the Worts Fund to Mr T R Parsons, Sidney Sussex College, towards expenses incurred in studying with Prof Orbeli of Leningrad the operative procedure used in research by the physiologists of the Pavlov School, and to Mr K de B Codrington, Corpus Christi College, towards the expenses of a visit to India for the purpose of carrying out archæological research at Elura, Hyderabad State, and at Badami, Bombay Presidency, and of making moulds of the sculpture

It is proposed to erect the new Pathological Laboratory on the Downing site near the Biochemical Laboratory and the Molteno Institute of Parasitology.

Emmanuel College is offering to a research student commencing residence at the University in October 1925, a studentship of the annual value of 150*l*, which will be tenable for two years Applications must reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than July 31 The award will be made on the evidence submitted by the candidates, which must include a brief statement of the proposed course of research and evidence of general ability and of special fitness for the proposed course of research

GLASGOW.—The late Dr. John Hall, a graduate of Glasgow, of St. John's Wood, London, who died in 1909, left the reversion of one-half of his estate to the University, for the foundation of tutorial fellowships in medicine, surgery, and obstetrics, for the better equipment of the practical classes in these subjects, etc. Through the death of his sister, who has added half her own estate to that of her brother, the large endowment has now accrued, and may amount to some 50,000*l*. when the estates are realised. The benefaction will be of great use to the University's large school of medicine, which now exceeds in numbers and in clinical resources any other in the kingdom.

Dr. J. S. Haldane, fellow of New College, Oxford, has been appointed Gifford Lecturer at Glasgow for the years 1926, 1927.

MELBOURNE.—Applications are invited for the professorship of agriculture and the post of research physicist. Conditions of the appointments may be obtained from the Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2. The latest date for the receipt of applications is May 31.

APPLICATIONS are invited, until April 18, for the professorship of philosophy at the University College of Swansea. Particulars of the post may be obtained from the College Registrar, Singleton Park, Swansea.

AN election to Beit fellowships for scientific research at the Imperial College of Science and Technology, South Kensington, will take place in July next. Applications must be received on or before April 18. Forms of application and all information can be had by letter addressed to the Rector of the College.

VISCOUNT BURNHAM will deliver an address on "Technical Education as it affects Employers of Labour" on Friday, March 27, at 8 P.M., at the Battersea Polytechnic, London, S.W.11. The Governing Body of the Polytechnic has extended an invitation to the London County Council Joint Standing Conference of Evening Institutes in the district to hold at the Polytechnic an Exhibition of Work done by students on Friday evening and Saturday afternoon and evening, March 27 and 28, while the laboratories, workshops, kitchens and demonstration rooms of the Polytechnic will also be open for inspection.

SOME of the inner working of a preparatory school on modern lines is shown in a pamphlet entitled "St. Piran's Year Book for 1924," recently received. Few people realise how fundamentally wrong is the system of so-called education in a great many preparatory schools where the only object seems to be to cram in a knowledge of a few subjects—principally Latin and Greek—to meet the requirements of the Common Entrance Examination. How this can be expected to encourage latent ability, even for languages, much less to reveal a boy's true bent, passes comprehension. Every schoolmaster admits what Mr. Secretary Cecil said to Roger Ascham, very wisely and most truly, when the great plague was at London in 1563: "Many young wits be driven to hate learning before they know what learning is." The headmaster of St. Piran's, Maidenhead, has shown in a very practical way how scholarships can be won and examinations passed without serious detriment to education in the true sense of the word. Natural science, for example, is taught to the boys at St. Piran's although the Common Entrance Examination does not require it. An engineering shop, various societies—literary, natural history, wireless, photographic, gardening—and lectures on subjects of current interest provide stimuli calculated to reveal latent ability. This is, or should be, the true aim of all education. To the impartial mind it appears that this out-of-date Common Entrance Examination condemns the boys in most preparatory schools to do merely school work in school, while the education, if any, they may have the luck to acquire is most likely to be picked up in out-of-school hours.

THE Battersea Polytechnic's report for 1923–24 shows 2735 as the total number of students, 447 being full-time and 2288 evening and other part-time students. The full-time courses were chiefly in the Training College of Domestic Science, and in engineering. Of the entries for part-time work about a third were for mechanical engineering and building and electrical engineering, a third for physics, chemistry, and mathematics, and the rest for women's subjects, music, hygiene and physiology, matriculation classes, physical training, and art. The figures are large, but a comparison with the figures for previous years is disquieting. The Principal points out that there is a steady decrease in numbers, and says it is largely due to the increased fee for out-county students (to cover the difference between the ordinary fee and the cost to the L.C.C. of the student's education) and the cessation of work under the Government scheme for the higher education of ex-service students. The decrease in the number of full-time students is fully accounted for by these reasons, but there remains a large decrease, nearly 600, in the number of evening students (comparing 1919–20 with 1923–24), attributable in part it may be supposed to the slump in the engineering trades. An interesting development in the Department of Hygiene and Public Health is the institution of a course in practical home dietetics (gas-ring or oil-stove cooking) for bachelor men and women. The enrolments in this department show a substantial increase.

THE international interchange of university students and university teachers has attracted much notice since the War. Many post-War organisations—the League of Nations' Committee on Intellectual Co-operation, the International Confederation of Students and its affiliated national unions, and many others, as well as older associations, such as the League of the Empire and Victoria League, make the fostering of such interchange one of their chief objects. The Universities Bureau of the British Empire has an Interchange Committee, consisting mainly of the Interchange Correspondents of the Bureau in the home universities, and has for several years printed and circulated annually a list of students from other countries in the universities and university colleges of Great Britain and Ireland. To the list for the current academic year is appended a list of university professors and lecturers of these universities who in 1923–24 visited universities in other countries and vice versa. No official sources of information exist regarding the visits of university teachers, since many of them are arranged without the official cognisance of the registrars of the home universities: indeed, the list is so scanty as to suggest that the visits of these "merchants of light," as they have been called, resemble, in being few and far between, if in no other respect, the visits of angels. Nevertheless the list is interesting as a pioneer attempt which should be repeated with more success. When one considers the expenditure incurred in the world of finance and commerce in recording and publishing statistics of imports and exports of material commodities, one wonders that the learned world has not long ago insisted on receiving systematic intelligence of the interchange of savants.

Early Science at Oxford.

March 23, 1685–6 An abstract of Mr Bent's travailes in France, was communicated by Mr Welsteed, and read —Mr Walker delivered in papers on an empiricall way of curing ye Cramp by a piece of ye root of fflag, and on Second-sighted men in Scotland, concerning whom Dr Garden was desired to give his opinion

March 24, 1684–5 Mr Dalgarno advocated the bringing of a Philosophicall Language into practice He also presented a compendium of a book, not long since printed by him, entitled *Didascolcophus*, which among other things undertakes to prove, that the Eye & Hand are more useful organs of knowledge, than the Tongue and Ear This gave occasion to some discourse concerning the Vigour and improvement of some one Sense, upon the Defect, or non-employment of one or more of the others, upon which subject Mr President was pleased to informe us, that Mr Whaly (the deaf gentleman, whom he taught to speak) could, when within doors, distinguish a coach from a cart in ye street by the motion, it made, when those, who were in company with him, could not discern whether it were the one, or the other, by the noise, it made

March 26, 1684–5 Ye Rt Honorable the Lord Visct Weymouth, in answer to Dr Plot's queries, concerning ye splitting of Trees by ye late Frost, wrote that great damages in this kind have befallen ye timber trees in most of ye northward midland counteys, but very little or none in ye western counteys of England

Ordered that ye thankes of this Society should be returned to Mr Molineux of Dublin for his ingenious discourse concerning ye Petrifications of Lough-neagh in which it having been affirmed, that these petrifications are sometimes found in ye earth near ye Lough, it was queried, whether ye earth, in which these petrifications are sometimes found, may be supposed to have been thrown up from ye Lough? It was then proposed by Dr Beeston, that ye Petrifying Springs in, and near Oxon, should be strictly examin'd, particularly as to their chymicall principles, and that enquiry should be made into ye severall steps, and progress, of their respective petrifications —Mr Packer, Physitian of Reading, gave an account of some observations he made lately in ye dissection of a Bear, particularly that there was no *Cæcum*, & that ye æsophagus consisted of so narrow a channell, and ye stomac, and entrails, are so well fixed in ye abdomen, that it was altogether impossible, they could at any time fall into ye mouth, as it was formerly supposed it might be in some postures of this animall It was ordered, that thankes should be returned to Mr Packer, and that he be desired to continue a correspondence with us

March 27, 1688 Dr Plot gave the Society the sight of a Paper written for his Majesty's use, about felling Timber in Staffordshire, where they bark their trees in the spring and cutt them down in winter, which hardens the timber, soe that the outside is as hard as the heart of the tree For felling wood in winter he brings the authority of the antients, Pliny, Theophrastus, Cato, &c for the advantage of it He shewed how the barking of it in the summer farthers the hardening by closing the pores in the evaporation of the juice by the heat of the sun There is no objection against it but that t'will be more troublesome to fell the Timber so hardened, and to bark it standing, and so dearer, but the goodness will sufficiently answer the price

Societies and Academies.

LONDON

Royal Society, March 12 —Sir Charles Sherrington Remarks on some aspects of reflex inhibition Attempt is made to schematise in a diagram certain features of the interaction of central inhibition and excitation Assumption is made of an inhibitory agent liberated centrally which neutralises chemically an excitatory agent when this latter is present, but the liberation of which is not dependent on pre-existence of the excitatory agent Tetanic inhibition is dealt with as due to iterate production of the inhibitory agent, with exhibition of temporal summation and "recruitment" Central after-action, both inhibitory and excitatory, is attributed to temporary persistence of a residuum of the liberated inhibitory or excitatory agent The schema is designed to meet in particular the experimental data furnished by the knee-extensor under crossed excitation and ipsilateral exhibition It does not attempt to deal with late successive effects such as successive induction and rebound —E G T Liddell and Sir Charles Sherrington Recruitment and some other features of reflex inhibition Under mere prolongation of an otherwise unaltered stimulus of the inhibitory afferent nerve, the central inhibitory process recruits more motoneurones as it proceeds The "stimulation-plateau" of the reflex contraction is more easily inhibited than the "after-discharge plateau" Experiments suggest that a reflex maintains maximal response of the individual "motor-unit" by a degree of central excitation which is commonly "supramaximal," *i e* of intensity above the lower limit required for evoking the unit's maximal response In the excitatory reflex, a mechanism proximal to the motoneurone axon seems to react in an "all-or-none" manner when exposed to inhibition —D T Harris Studies on the biological action of light Ultra-violet radiations exert a stimulant action on the gaseous metabolism of small animals, and on the movements of the frog's isolated stomach This action is completely annulled by the presence of visible radiations, an action which seems to be physiological antagonism rather than physical interference Exposure of an animal to mixed radiations of a powerful source of light depresses its heat production to an extent greater in pigmented animals than in albinos for the same rise of temperature in the surrounding medium Thermo-electric measurements indicate that pigment, nevertheless, possesses high absorptive properties Pigment appears to protect an animal against the lethal action of certain photo-dynamic substances —H Hartridge and F J W Roughton The kinetics of hæmoglobin III Velocity with which oxygen combines with reduced hæmoglobin The reaction between oxygen and reduced hæmoglobin is very rapid, the time required for half-completion being 0 01 to 0 001 sec The velocity-constants obtained at P_H 7 and P_H 10, with different concentrations of hæmoglobin and oxygen, agreed in showing that the reaction is bimolecular The dissociation curve for dilute hæmoglobin solutions is approximately hyperbolic The quotient of the two velocity-constants, oxidation and reduction, is practically equal to the equilibrium constant The presence of hæmoglobin aggregates would not be expected to affect the velocity of oxidation, so long as the part of the molecule with which the oxygen combines is sharply localised and far removed from the aggregate-forming portion This affords an explanation of the low-temperature coefficient obtained —S B Schryver, H W Buston and D H Mukherjee The isolation of a product of hydrolysis of the proteins hitherto undescribed By

means of the "carbamate" method, a base $C_6H_{14}O_3N_2$ has been isolated from isinglass It differs from the other basic products of hydrolysis of the proteins in that it yields a barium carbamate insoluble in water It gives a tri-benzoyl derivative $C_6H_{11}O_3N_2(C_6H_5CO)_3$ m p 68-69°, and it is assigned the formula CH_2 (NH_2) CH_2 CH_2 $CH(OH)CH_2$ (NH_2) CO_2H It has been found after hydrolysis of fish gelatin, isinglass and three vegetable proteins of very diverse origin It is absent from, or present only in very small traces in, the hydrolysis products of gelatin of mammalian origin, of casein, fibrin, and egg-white —D. **Keilin** On cytochrome a respiratory pigment common to animals and yeast Under names myohæmatin and cytohæmatin, McMunn described a respiratory pigment, here named cytochrome Cytochrome, in reduced form, shows a very characteristic spectrum, with four bands (*a*, *b*, *c*, *d*), with positions of maximum intensity *a*, 603, *b*, 565, *c*, 550, *d*, 523 In the oxidised form no absorption bands can be seen In different concentrations cytochrome exists in tissues of all animals, *e g*, worms, molluscs, arthropods and vertebrates It is also present in cells of ordinary baker's yeast, a thin layer of which shows well the above four bands The highest concentration of cytochrome is found in thoracic wing-muscles of insects, striated muscles of mammals, and yeast-cells It yields various derivatives similar to hæmochromogen and its oxy- and CO-compounds, and porphyrin Cytochrome may co-exist with other respiratory pigments, and may be considered an intracellular respiratory pigment, generally distributed, forming part of a complicated system of respiratory catalysts

Royal Microscopical Society (Industrial Applications Section), January 28 —R Stenhouse **Williams** The microscope of fundamental importance to the dairying industry —Norman **Wright**. The structure of the udder, normal and abnormal The solids-not-fat (lactose, protein, and ash of milk) are secreted in very constant concentration, owing probably to their osmotic properties, the fat bears no relation to the other constituents, since, owing to its insolubility, it has no osmotic pressure The control of rate of fat secretion is dependent upon the rate of formation in the gland (probably constant), and the fact that the cell membrane must be penetrated in order to liberate the fat globules The importance of correlation between the constituents of blood and of milk is emphasised —A T R **Mattick** · The enumeration and differentiation of the various cellular elements of milk, by means of the microscope On account of the enormous differences in numbers of cells found in the milk of different cows and even in different quarters of the same cow, no such standard can justly be adopted The method of differentiating between the various types of cells by the use of stains such as Jenners, and finding by means of the microscope the relative frequency of occurrence of the different types, is more promising Whilst the differential method of Varrier-Jones seems to offer considerable promise, more work on the varieties of cells found in different breeds and under different conditions must be done —L J. **Meanwell** The application of the microscope to the detection of tuberculous infection Great care must be exercised before assuming that acid-fast bacilli in market milk are of tubercular origin By the use of the usual routine method of microscopical examination, 20 per cent of infected milks are detected As this method is not satisfactory, animal inoculation must be performed before a report can be given The disadvantages of the animal inoculation method of examination are said to be · (1) Expense, (2) the lapse of time necessary before a report can be given, and (3) the difficulty in tracing the source of infection 25 per cent of milking cows are affected with tuberculosis, and in certain districts 4 per cent of the milking cows show, on post-mortem examination, tuberculous lesions of the mammary gland —J **Golding** Fat globules "Adsorption films" of the nature of "gels" seem to explain the observations made on milk globules as well as on other emulsions Observations on the differences in time of churning of the milk of individual cows support the conclusion of other workers that "individuality" may play at least as important a part as "breed" in this respect The expense and difficulty of accurate estimations of size of fat globules do not encourage the use of the microscope in this direction The microscopical examination of butter under polarised light yields more definite results in the comparison of butter and margarine —Miss E R **Hiscox** The separation and identification of the micro-organisms causing faults in milk products In the first method (moist chamber) a well-isolated cell is kept under observation under the microscope until the resultant colony is large enough to be transferred to a tube of culture medium In the second (Barber's method) small drops of an emulsion of the cells are blown on the lower surface of a coverslip by means of a micropipette Drops containing a single cell are transferred to tubes of the culture medium Although physiological reactions are of primary importance in the identification of micro-organisms, microscopical observation of the size and shape (bacteria), form of budding and spore formation (yeasts), form of branching and type of fructification (moulds), may also be of great value

Physical Society, February 13 —F E **Smith** A system of electrical measurements The study of the absolute measurement of electrical quantities, though usually regarded as difficult, is not beyond the comprehension of junior students if suitably presented The electrical units as theoretically defined and the practical standards by which they are represented differ, but an incorrect standard can be brought into more precise accordance with its theoretical unit without inconvenience to industry. The increased refinement of measurements calls for a redefinition of the practical standards, and this could be effected without inconvenience, since the most probable values of the standards lie within the limits prescribed by the errors permissible in industrial measurements

PARIS

Academy of Sciences, February 2 —Maurice **Hamy**: The determination of the radial velocities of stars The application of the Doppler principle to the determination of the radial velocities of stars is now known to require certain corrections The alteration of the wave-length by pressure has been proved, and the Einstein gravitation effect must also be taken into account A Michelson has also pointed out the necessity for another correction due to the fact that most radiations are not simple An international agreement relating to the comparison lines to be used in the determination of radial velocities is much to be desired —G **Bigourdan** · The perturbations of the Hertzian waves during transmission to great distances A table is given showing monthly, quarterly and annual means, the general mean of the annual values is 0 013 sec —André **Blondel** A new method for the harmonic analysis of the curves of electromotive force of alternators Two methods are described and discussed, one making use of a thermionic amplifier, the other working with a condenser —Pierre **Weiss**.

The magnetic equation of state and variation of the atomic moment —M Eugène Fichot was elected a member of the section of geography and navigation in succession to the late E Bertin —A **Kolmogoroff** The possibility of the general definition of the differential, the integral, and the summation of divergent series —J **Haag** Euclidian action at a distance —P **Fatou** The movement of a material point submitted to the attraction of a flattened spheroid —A **Barbaud** and R **Le Petit** The measurement of the wind in an aeroplane and its effects on the route followed —J **Cathala** A recording apparatus for the control of the insulation of enamelled wires Enamel has been used in late years to an increasing extent as an insulating material for wires, but the wire thus covered always has a certain number of microscopic cracks, where the insulation is nil In the apparatus described and figured the wire is rapidly drawn through a mercury bath and the weak spots detected —Léon **Guillet** and Albert **Portevin** The influence of tempering on the mechanical properties of steel after reheating Whenever the nature of the metal permits the production of different constitutions by tempering, the results of mechanical tests obey the following rule for equal final hardness after reheating, the resilience is better for the completely tempered states, that is to say, those formed of pure martensite Inversely, for equality of resilience after reheating, the final hardness is always higher as the temper hardness is higher —V **Auger** and Mlles L **Lafontaine** and Ch **Caspar** Some salts of cupferron Details of the properties of 21 metallic compounds of cupferron —O **Gaubert** The modification of the facies of crystals as the result of their syncrystallisation with a foreign material dissolved in the mother liquor —Albert Michel **Levy** The birth of biotite in the crushed granites and rhyolites of Morvan —E **Tabesse** Magnetic measurements in Normandy and Brittany —H **Hérissey** and J **Cheymol** The extraction and properties of geine, a glucoside giving rise to eugenol, contained in *Geum urbanum* This glucoside was extracted from the fresh underground parts of herb-bennet, in the proportion of about 0 1 per cent. On hydrolysis, it gives eugenol, *d*-glucose and *l*-arabinose in equimolecular proportions —M **Bridel** and C **Charaux** The process of blackening of Orobanche in the course of drying —L **Blaringhem** New observations on Xenia in wheat —Ad Davy de **Virville** The biological relations between a liver-wort (*Lophocolea bibentata*) and various Muscineæ —N **Kleitmann** and H **Piéron** The velocity of establishment of the light sensation and the magnitude of the undulation of pre-equilibrium for monochromatic stimulations of variable intensity —E **Fauré-Fremiet** The quiescent state and active state in the amibocytes of Arenicola —C **Hosselet** The œnocytes of *Culex annulatus* and their chondriome in the course of secretion —C **Levaditi** and A **Girard** The mode of action of bismuth in syphilis A quantitative method has been developed capable of detecting 0 001 milligram of bismuth, and this has been applied to the estimation of bismuth in various organs of the rabbit after treatment with trepol (alkaline tartro-bismuthate) Infinitesimal traces of bismuth (0·002 mgm) are sufficient to destroy the parasite

Official Publications Received.

Department of the Interior Bureau of Education Bulletin, 1924, No 10 Statistics of Teachers Colleges and Normal Schools, 1921–22 Prepared under the Direction of Frank M Phillips Pp 76 10 cents Bulletin, 1924, No 22 Technique of Procedure in Collegiate Registration By Prof George T Avery Pp 26 5 cents Bulletin, 1924 No 24 Organization and Administration of the Duplicate School in Philadelphia, Pa. By Edwin Y Montanye Pp 16 5 cents Bulletin, 1924, No 25 A Platoon School in Kansas City, Missouri By G W Diemer Pp iii+25 5 cents (Washington Government Printing Office)

United States Department of Agriculture Department Bulletin No 1313 Fumigation against Grain Weevils with various Volatile Organic Compounds By Ira E Neifert, F. C Cook, R C Roark, W H Tonkin, E A. Back and R T Cotton Pp 40 (Washington Government Printing Office) 10 cents

Contributions from the Princeton University Observatory, No 7 Photometric Researches The Eclipsing Variables, TV Cassiopeiæ, TW Cassiopeiæ, TX Cassiopeiæ, T Leonis minoris, SS Camelopardalis By Richard John McDiarmid Pp 64 (Princeton, N J)

Bulletin of the National Research Council Vol 8, Part 2, No 44 The Continental Shelf off the Coast of California By Andrew C Lawson Pp 23 25 cents. Vol 8, Part 4, No 46 The Geological Implications of the Doctrine of Isostasy By Andrew C Lawson Pp 22 40 cents (Washington National Academy of Sciences)

Cornell University Agricultural Experiment Station Memoir 68 The Lepidoptera of New York and neighboring States Primitive Forms, Microlepidoptera, Pyraloids, Bombyces By William T M Forbes Pp 729 (Ithaca, N Y)

Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30, 1924 Pp vi+290 (Washington Government Printing Office) 60 cents

International Geodetic and Geophysical Union (Union Geodesique et Geophysique Internationale) Section of Terrestrial Magnetism and Electricity Bulletin No 4 Terrestrial Magnetism and Electricity at the Madrid Meeting, October 1924, General Report By Louis A Bauer Pp 10 (Baltimore, Md Johns Hopkins Press) 25 cents

Department of the Interior, Canada Publications of the Dominion Astrophysical Observatory, Victoria, B C Vol 3, No 1 The Absolute Magnitudes and Parallaxes of 1105 Stars By R K Young and W E Harper Pp 143+4 plates (Ottawa F A Acland)

Journal and Proceedings of the Royal Society of Western Australia Vol 10, 1923–1924 Pp xxvii+129+11 plates (Perth)

Department of Commerce U S Coast and Geodetic Survey. Serial No 275 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md, in 1921 and 1922 By Daniel L Hazard Pp 96+5 plates (Washington Government Printing Office) 10 cents

Legislative Assembly New South Wales Report of the Director-General of Public Health, New South Wales, for the year 1923 Pp v+157+19 graphs (Sydney Alfred James Kent) 7s 3d

Ministry of Finance, Egypt Coastguards and Fisheries Service Report on the Fisheries of Egypt for the year 1923 By G W Paget. Pp v+43 (Cairo Government Publications Office) 5 P T

Instituts Scientifiques de Buitenzorg "'s Lands Plantentuin" Treubia Recueil de travaux zoologiques, hydrobiologiques et oceanographiques Redigé par Dr W M Docters van Leeuwen, Dr K W Dammerman et Dr H C Delsman Vol 5 Supplement, Septembre 1924 Pp 142+5 Tafeln (Batavia Landsdrukkerij)

Department of Agriculture, Ceylon Bulletin No 70 Guide to the Central Experiment Station, Peradeniya By T H Holland and H A. Deutrom Pp 112+6 plans Bulletin No 71 Entomogenous Fungi and their Use in Controlling Insect Pests By T Petch Pp 40+2 plates (Colombo) 40 cents each

Union of South Africa Department of Agriculture Science Bulletin No 34 Kemp Fibres in the Merino Sheep By Prof J E Duerden and Miss M Ritchie Pp ii+18 (Cape Town *Cape Times*, Ltd) 3d

South Australia Department of Mines Mining Review for the Half-year ended June 30th, 1924 (No 40) Pp. 66+5 plates (Adelaide R. E E Rogers)

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 53 The Effect of Irrigation upon Soil Temperatures By Dr E McKenzie Taylor. Pp 18+7 plates. Bulletin No 51 A Statistical Note on the Cotton Variety Tests at Sakha, 1916–1920 By Trevor Trought. Pp 16 (Cairo Government Publications Office) 5 P T each

Torquay Natural History Society Transactions and Proceedings for the Year 1923–24 Edited by the Rev James A Balleine and H. L Earl Vol 4, Part 2 Pp 101-198 (Torquay.)

The Carnegie United Kingdom Trust Eleventh Annual Report (for the Year ending 31st December 1924) submitted by the Executive Committee to the Trustees on Friday, 27th February 1925 Pp. ii+89 (East Port, Dunfermline)

Smoke Abatement League of Great Britain Report of the Smoke Abatement Conference held at the Town Hall, Manchester, November 4th, 5th and 6th, 1924 Pp xi+308 (Manchester Hon Secretary, 33 Blackfriars Street.) 5s 6d

Diary of Societies.

SATURDAY, MARCH 21

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11 A M —Miss E Green The Development of Zygorhynchus —W F Hanna Sex in the Genus Coprinus —J Ramsbottom Fragmenta Mycologica III —Dr M C Rayner Sectoring in Cultures of *Phoma radicis Callunæ* —Miss A Lorrain Smith (I) Notes on Myxobacteriaceæ, (II) Templeton's Drawings of Fungi and Lichens

PHYSIOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 3 —E H J Schuster Adjustable Pump for Artificial Respiration or Perfusion —A. C Downing (*a*) Magnet Systems for Sensitive Galvanometers, (*b*) Some Recent Muscle Thermopiles, (*c*) A Sensitive Compton Electrometer —N Kubo and Prof A. V Hill The Effect of Length on the Heat-production of Muscle —Phyllis M Kerridge Modified Glass Electrodes —J Wyman The Viscous-elastic Properties of Tortoise's Muscle —W Shaw The Relation of the Corpus Luteum to the Pre menstrual Changes of the Endometrium —J R Pereira The Patellometer Measurement of the Threshold Stimulus and Recording of the Knee jerk —D T Harris Action of Light on the Affinity of Hæmoglobin for Oxygen —W K Slater A Micro respiration Apparatus —H A. Ellis A Rapid Colorimetric Method of Measuring the C_H of Blood —Dr C Da Fano Modification of the Hewer Method for Staining in Bulk with Hæmatoxylin and Eosin —H I Coombs and T S. Hele: The

Effect of Phenols on the Sulphur Metabolism of the Dog —Prof J S Macdonald Rectal Temperatures observed in Cycling Experiments —W Smith and L B Winter Insulin and Micro-organisms —L N Katz and C N H Long A Comparison of the Lactic Acid Content of Heart and Skeletal Muscle after Stimulation and in Rigor Mortis —Prof T H Milroy Carbohydrate and Phosphate Metabolism in Muscles during Hyperglycæmia —J Hoet The Action of Atropine on the Gut —F Aveling, R J S McDowall, and H Wells The Physiology of the so called "Psychogalvanic Reflex"—A St G Huggett and Prof J Mellanby The Action of Adrenalin, Ergotamine, and Curare on Muscle Tonus and Decerebrate Rigidity —Dr G V Anrep Observations on Pulmonary Circulation —H N Segall The Isometric Contraction and Relaxation of the Frog's Heart —Dr G V Anrep and H N Segall The Bainbridge Reflex —H E Kinnersley, R A Peters, and J T Squires Animal Quinoidine —G S Adair The Equilibrium of Oxygen and Hæmoglobin

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College, Regent's Park), at 3 —R. H Thouless The Physics of the Psychogalvanic Reflex Phenomenon —Rev R C McCarthy The "Determining Tendency" and Conation

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford · The Counting of the Atoms (IV)

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch Junior Section) (at Manchester College of Technology), at 7 —H Stead Plate Moulding and the Patternmaker

HULL ASSOCIATION OF ENGINEERS (at Hull Technical College), at 7 15 —— Elce Steam Turbines

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich) —Dr H M Cade: The Germ Theory of Disease (Pathogenic Bacteria)

MONDAY, MARCH 23

ROYAL SOCIETY OF EDINBURGH, at 4 30 —Dr A Balfour Reflections on Malaria

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —W J Bryan Man and the Divine Image

ROYAL SOCIETY OF MEDICINE, at 5 30 —Dr W Hunter, Dr R Hutchinson, and others Special Discussion (continued from February 16) on Non-specific Disturbances of Health due to Vitamin Deficiency

INSTITUTE OF CHEMISTRY (Leeds Section) (at Leeds University), at 7 —R B Pilcher Alchemists and Chemists in Art and Literature

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —R Grierson and others Discussion on Panel Heating

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Mining Institute, Newcastle on-Tyne), at 7 15 —Col T F Purves The Post Office and Automatic Telephones

ROYAL SCOTTISH SOCIETY OF ARTS (at 117 George Street, Edinburgh), at 8 —Prof W Peddie The Construction of Solid Materials

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8 —G J Harborow A Dental Cyst in Connexion with a Deciduous Tooth —A Livingston The Permeability of Enamel

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —F G Binney Across North-East Land

MEDICAL SOCIETY OF LONDON, at 8 30 —L B Rawling, Sir William Willcox, and others Discussion on Oxaluria

TUESDAY, MARCH 24

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr J A Ryle The Study of Gastric Function in Health and Disease (Goulstonian Lectures) (III)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof. A S Eddington The Internal Constitution of the Stars (I)

INSTITUTION OF CIVIL ENGINEERS, at 6 —P W Robson The Large Water tube Boiler

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at University College, Nottingham), at 6 45 —Major E I David Electricity in Mines

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at 83 Pall Mall), at 7

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7 —H W Clothier The Design of Electrical Plant, Control Gear, and Connexions for Protection against Shock, Fire, and Faults

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —J F Young Perspective

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7 15 —C Walker Automobile Steels and Irons

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30 —Discussion on Internal Combustion Turbines, Prof W J Goudie, and The Manufacture of Brass Condenser Tubes, with some Notes on an Alternative Alloy, G H Whiteman and A Spittle

ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, and Pathology Sections), at 8 —Sir Thomas Horder (Medicine), R P Rowlands (Surgery), and others The Treatment of Septicæmia

ROYAL ANTHROPOLOGICAL INSTITUTE (at 52 Upper Bedford Place, W C 1), at 8 15 —Sir Aurel Stein . Innermost Asia its Geography as a Factor in History

WEDNESDAY, MARCH 25

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —C Barrington Brown and R. A. Baldry The Clay Pebble-Bed of Ancon (Ecuador) —J I Platt The Pre-Cambrian Volcanic Rocks of the Malvern Inlier

INSTITUTION OF CIVIL ENGINEERS (jointly with Institution of Mechanical Engineers, Institution of Electrical Engineers, Institution of Naval Architects, Institute of Marine Engineers, North-East Coast Institution of Engineers and Shipbuilders, Institution of Engineers and Shipbuilders in Scotland, Institute of Chemistry of Great Britain and Ireland, Institution of Gas Engineers, British Electrical and Allied Manufacturers' Association, British Engineers' Association), at 6 —W H Patchell A Standard Code for Tabulating the Results of a Steam-Generating Plant Trial

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at 244 Deansgate, Manchester), at 6 30 —A F Burstall Experiments on a High-speed Gas Engine

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle and Middlesbrough Graduate Sections) (at Bolbec Hall, Newcastle upon-Tyne), at 7 15 —Calderwood The Possible Influence of Recent Research on Propeller Design

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7 30 —F H Walker The Sampling of Coal

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7 30 —Dr J A Murray The Making of Microscopical Preparations (II) Imbedding and Section-cutting —Prof P Groom The Microscopical Investigation of Fungal Attacks on Wood —A P H Trevelli and R P Loveland The Application of Microscopy to the Photographic Industry

ROYAL SOCIETY OF ARTS, at 8 —H G Dowling Wall papers

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8 —Dr J A Hadfield, Dr J Glover, and A F Shand Discussion on The Conception of Sexuality

THURSDAY, MARCH 26

ROYAL SOCIETY, at 4 30 —Prof O W Richardson and T Tanaka Regularities in the Secondary Spectrum of Hydrogen —Prof S Chapman The Lunar Diurnal Magnetic Variation at Greenwich and other Observatories —H T Flint A General Vector Analysis with Applications to Electrodynamical Theory —Miss M O Saltmarsh The Spectra of Doubly- and Trebly Ionised Phosphorus (P III and P IV) —*To be read in title only* —Dr D M Wrinch and Dr J W Nicholson Laplace's Equation and the Inversion of Surfaces of Revolution —Prof T R Merton and J G Pilley Experiments relating to the Spectrum of Nitrogen —Prof T H Havelock Studies in Wave Resistance the Effect of Parallel Middle Body —T Tanaka Wave lengths of Additional Lines in the Many-lined Spectrum of Hydrogen

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H Cameron Some Forms of Vomiting in Infancy (Lumleian Lectures) (I)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —T Thorne Baker Chemical and Physical Effects of Light (I)

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5 30 —Dr Eckener Modern Zeppelin Airships

INSTITUTE OF CHEMISTRY (Belfast Section) (at Queen's University, Belfast), at 7 30 —Dr W H Gibson The Union of Chemical Societies

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7 30 —Gibson Maximum Performance and Balance of a Four-cylinder Engine

FRIDAY, MARCH 27

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 3 30 —Dr Helen Dent, Mrs C J Bond, and others Discussion on Maternity and Child Welfare Work

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Demonstration of Specimen illustrating the Commoner Congenital Malformations of the Lower Limb

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 5 30 —Discussion on Smoke Abatement

INSTITUTE OF MARINE ENGINEERS, at 6 30 —Annual Meeting

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at 36 George Street, Manchester), at 7

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Discussion on The Cutting of Heavy Steel Sections

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —H. Felton The Thames (Lecture)

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —A P Morris Irrigation Engineering in Burma.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle upon-Tyne), at 7 30 —Eng Lieut Comdr L J Le Mesurier Conversion of the s s *Bintang*

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 —S Stansfield Investigations of Stresses in the Rotating Parts of Steam and Internal Combustion Engines

ROYAL SANITARY INSTITUTE (at Town Hall, Leicester), at 8 —Prof H R Kenwood Healthy Living—Facts and Fads (Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Ernest Rutherford Studies of Atomic Nuclei

SATURDAY, MARCH 28

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof J H Ashworth The Nervous System and Some Reactions (I) Of Ciliate Protozoa and Sea Anemones

PUBLIC LECTURES.

SATURDAY, MARCH 21

UNIVERSITY COLLEGE, at 3 —Dr F M Feldman Post-Natal Child Physiology and Hygiene (Chadwick Lecture)

HORNIMAN MUSEUM (Forest Hill), at 3 30 —S Hazzledine Warren Who were the First Men ?

WEDNESDAY, MARCH 25

UNIVERSITY COLLEGE, at 5 30 —Prof T B Wood The Nutrition of the Young Animal (III)

THURSDAY, MARCH 26.

SOUTH PLACE INSTITUTE (South Place, Moorgate, E C), at 7 —Sir Arthur Keith The Religion of a Darwinist (Moncure Conway Memorial Lecture)

SATURDAY, MARCH 28

HORNIMAN MUSEUM (Forest Hill), at 3 30 —H N Milligan. Living Animals of the Sea Shore.

SATURDAY, MARCH 28, 1925.

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Editorial and Publishing Offices
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Scientific Officers in Tropical Agriculture.

MR ORMSBY-GORE, Parliamentary Under-Secretary of State for the Colonies, speaking at the annual dinner of the National Union of Scientific Workers on March 19, emphasised the need for many more highly trained scientific officers in British colonial possessions His recent visit to East Africa with Major Church, secretary of the Union, as members of the East African Parliamentary Commission, revealed to him some of the problems which could be solved only by the use of scientific knowledge, and developments which can come from scientific guidance alone He regarded the present position as to officers and institutions concerned with tropical agriculture as "a disgrace to the Empire"

The earliest appointments of this class of scientific officers in tropical agriculture were the heads of the various tropical botanic gardens, usually systematic botanists, whose concern with agriculture was only a limited one, their principal duties being the introduction of possible useful plants, and the investigation of the local flora. The first officer of a more specialist type to be appointed in the British tropical colonies was the late Prof Marshall Ward, who was sent to Ceylon in 1882 to investigate the coffee leaf disease (*Hemileia vastatrix*) and to endeavour to find some remedy for the already desperate position of affairs. But his advent upon the scene was much too late for any remedy to be applicable that was within the means of the planters, and the visit was unsuccessful, so that public opinion was set against such appointments A little later, however, the well-known Dr Treub obtained quite a considerable staff of specialist scientific officers at the great Dutch colonial institute in Java, to which Mr. Ormsby-Gore paid high tribute

For a long time no further appointments were made in the British tropical colonies, and the next, so far as we are aware, was that of Mr. E E Green (now president of the Entomological Society), who in 1897 was made honorary government entomologist in Ceylon, with a small grant for expenses In the following year, Mr J Parkin was appointed assistant in Ceylon to investigate the chemistry and physiology of the coagulation of rubber latex Mr Green did such valuable work in his honorary capacity that in 1899 he was appointed full-time entomologist, while in the same year the newly formed Imperial Department of Agriculture in the West Indies appointed Mr Maxwell Lefroy (now professor at the Imperial College of Science, South Kensington) as entomologist, and Messrs Harrison and d'Albuquerque as honorary chemists.

From that time onwards the number of scientific men employed in the tropical colonies has steadily increased,

though at first public opinion was opposed to such appointments, on the supposition that scientific work was unlikely to have much bearing upon practice in agricultural matters This expansion is to some slight extent due to an element of good fortune which attended these pioneers, who were markedly successful in their early work, of which that of the first two may be quoted as an example Mr. Green, with years of practical experience as a tea planter, made recommendations for the treatment of disease which were at once practical, economical, and successful, while Mr Parkin devised the method of coagulation of rubber latex which is still followed At first, the appointments were chiefly of officers to deal with diseases, or of chemists to deal with soil questions, and in this and other ways the old botanic gardens in some of the most important tropical colonies developed into Departments of Agriculture

There are several essentials in the equipment of a scientific officer for the tropics, though naturally the training of each must vary with the duties which he is to undertake. These essentials are well set forth by Prof. Farmer in a pamphlet recently issued [1] In the first place, the officer must, of course, have a thorough knowledge of the science with which he is to be concerned, a knowledge best obtained at one of the universities, where he should have taken a good degree in honours Next in importance is a good general knowledge of tropical agriculture, and (especially in the case of officers like entomologists, who have to make recommendations which involve the outlay of money) of the economics of the various cultivations Such knowledge is best obtained in a tropical country, and if the individual cannot afford to spend some time at such a place as the Imperial College of Tropical Agriculture in Trinidad, he should learn his work by being attached as assistant to some officer with long experience of the tropics In the third place, the man should have a capacity for research, sufficient at any rate to enable him to find out the life-history of a disease, to test new plants or new conditions, to advise as to the best manures for unfamiliar soils, and such matters While this capacity is largely inborn, it may be much improved by work under a capable and experienced chief, under whom he may carry out definite pieces of research Finally, a most desirable part of the equipment is a capacity for giving—in speaking or in writing—clear and easily understood accounts of any work that has been carried out, whether his own or that of other workers It is through the work of men of this type, adequately trained and reasonably paid, that, as Mr Ormsby-Gore remarked, "we shall be justified in history as a great Imperial Power"

[1] "On the Training of Scientific Officers for Tropical Plantation Industry," by Prof J B Farmer Reprinted from the Official Report of the Brussels Conference, 1924, published by the Rubber Growers' Association, Inc

Philosophy and Science.

The Scientific Approach to Philosophy Selected Essays and Reviews By Prof H Wildon Carr Pp viii + 278. (London Macmillan and Co, Ltd, 1924) 12*s* net.

FOR centuries past, science and philosophy, in spite of their common origin in the evolution of human thought, in spite, also, of the continuous (and inevitable) influence of each upon the other, have slowly but steadily drifted apart, both as regards their method and supposed subject-matter and as regards the avowed aims and general attitude of mind of their respective exponents. During the past twenty years, however, there has been a marked reversal of this tendency, and it is fitting that Prof Wildon Carr should be one of the first to publish a systematic explanation of the causes and significance of the new movement, for he has done as much as any man to foster and encourage it

Prof Wildon Carr begins by pointing out that science and philosophy differ, not in their subject-matter, but in the mind's attitude towards it Philosophy seeks to see reality as a whole, but science is more concerned with particulars Philosophy proceeds from the whole to the parts, regarding the latter as significant only in their relation to the whole Science, on the other hand, considers the parts as having reality in their own right, and proceeds, not to a systematic whole, but to invariable laws It should perhaps be remarked that this view of the relation between science and philosophy is in fundamental contrast to that held, for example, by Mr Bertrand Russell For Mr Russell, science and philosophy start from the same point and with the same material, namely, the particular facts of experience, and it is these particulars and the relations which subsist between them which are the essential concern of both The difference between them lies in the fact that they proceed from their starting-point in opposite directions.

Prof. Wildon Carr considers that science and philosophy have reapproached through biology and electromagnetism, or, more particularly, through evolution and relativity. The dichotomy of Nature as objective reality and mind as ideal representation, assumed by science, has turned out unworkable Progress in science has raised, in connexion with science itself, metaphysical problems which are compelling us to reconstruct the whole basis of scientific thought The reproach, so often levelled at philosophy, that it is concerned with mere speculation regarding a transcendent reality, whereas science provides comparative certainty, is held by Prof Wildon Carr to be due to the nature of the older idealisms The "New Idealism," on the contrary, is the consciousness that the problems of science and philosophy arise from the

same subject-matter. It is in fundamental opposition to the "New Realism," for it regards activity and becoming as original, objects of ordinary experience as derived, and physical concepts as constructed; whereas the new realism assumes mind to be passive to the revelation of an external reality and active only in so far as it attends to what is thus presented

Bergson and Croce are taken as the chief exponents of the new idealism The importance of Bergson lies in his substitution of the concept of pure duration for that of pure extension This implies that reality is fundamentally psychical, for only what is psychical "endures" Prof Wildon Carr goes on to a discussion of Bergson's theories of mind-energy and of memory, in the course of which he indicates what, in the present writer's view, is a complete refutation of the theory (still held by some men of science) that brain produces mind Briefly, his argument is that the theory in question leads to a contradiction and a vicious circle, for it can only infer the existence of the external world from the existence of brain process, while at the same time it is compelled to infer brain process from the existence of the external world of which the body is a part.

There follows an interesting exposition of Croce's main theses, namely, that philosophy is not a science with a special (abstract) subject-matter, but a way of studying reality in its most comprehensive sense, while history is not the record of what was, but the interpretation of what is Hegel discovered the logic of philosophy—a special method of treating reality as a whole and not particular parts thereof, but he is criticised by Croce for failing to recognise that there are analogous logics of mathematics, science, history, etc, and for confusing the synthesis of contradictions with degrees of truth and reality

That portion of the book which deals with relativity will perhaps be of most interest to the scientific reader General relativity theory, if accepted, means the convergence of the two lines of intellectual development which we name science and philosophy It reforms the notions of substance (ether) and cause (force), and implies that reality is "monadic" (*i e* constituted by "monads" or "minds" considered as metaphysical reals), the "universe" of physics and common-sense being dependent on subjects of experience in the sense that it is the co-ordination which they effect In the result, materialism and natural realism cannot be indifferent to relativity, for their whole philosophy is at stake

For philosophy in general, Einstein's scheme is superior because its constitution is inherent in experience and does not transcend the conditions thereof It rejects an absolute *which is independent of experience*, and recognises as fundamental one of the chief tenets of monadism, namely, that there is no way of presenting the object of knowledge in complete detachment from the conditions of knowing

After an illuminating review of the work of Descartes and Pascal, Prof Wildon Carr concludes with a discussion of intercourse by means of speech. The problem here considered arises from the fact that individual experience is private and yet there is intercourse The author argues, in this connexion, that language is not an invention due to our reasoning powers, but a product of evolution We speak because we are organised to produce and respond to articulated sounds Language is dependent on an internal psychical structure—we reason because we speak, and not vice versa

It is in respect of this problem of intercourse and interaction between minds that a weakness appears in Prof. Wildon Carr's theories, and particularly with regard to the relation of body and mind, where it is argued that theory of intercourse is impossible if mind and body are distinct But the difficulties of regarding mind and body together as one individual monad are very great For example, such a view cannot account satisfactorily for the fact that the mind's relation to the body has a twofold character On one hand, a mind's relation to its own body is quite different in certain obvious respects from its relation to any other body, but, on the other hand, in no less obvious respects it is related to its own body (*e g.* when it sees it) in the same way as it is related to all other material bodies In fact, here and elsewhere, when dealing with this problem of intercourse and all that it implies, Prof. Wildon Carr seems too prone to conceive interaction solely on the model of mechanical interaction Indeed, on p 277 of his present work he says quite definitely that "intercourse between monads cannot be conceived as a form of mechanical interaction" But, quite apart from the fact that, if what he says about relativity is true, there is, strictly speaking, no such thing as *mechanical* interaction, he has not, in the writer's opinion, succeeded in proving that intercourse between monads may not be a type of relation which can fairly be termed "interaction," where action or activity is used in the sense in which he himself uses it, of monads or psychical reals, and not in the mechanical sense.

The book is written in Prof Wildon Carr's usual clear and eminently readable style Though it consists of a number of papers given originally in comparative independence of one another, the thread of the author's thought is continuous throughout. The theme of his study is of the greatest importance at the present time, and cannot fail to be of interest to all who wish to appreciate the real significance of the new convergence of those two streams of thought which have produced at intervals what are perhaps the noblest and mos profound creations of the human mind. C. A R.

Chemistry and the Quantum Theory.

A System of Physical Chemistry By Prof. William C McC. Lewis (Text-Books of Physical Chemistry) Third edition In 3 vols Vol 3 *Quantum Theory* With certain Appendices by James Rice, A. M'Keown, and R. O Griffith Pp x+407. (London Longmans, Green and Co, 1924) 15s net.

AN important test of the value of a scientific theory is its comprehensiveness It is a curious and, in some ways, a significant fact that the most detailed account of the quantum theory published in Great Britain (apart from translations) is written by a professor of physical chemistry and appears in a series of text-books devoted to that subject There are signs that the boundary lines between "classical" physics and chemistry, almost unknown to Faraday, will again be obliterated and the two subjects become united in a theory of wider generalisation. An Armstrong and an Arrhenius may worship together in a more magnificent temple dominated by the genius of Niels Bohr Chemists and physicists will no longer use different names for the same thing, but hark back to the point of view of Faraday, thus expressed by Poynting "The hypothesis with which we start is that electrical and chemical forces are identical, that electrification is a manifestation of unsatisfied chemical affinities and that chemical union is a binding together of oppositely charged atoms or groups of atoms"

We are all agreed that matter may be described as composed of light negative electrons and more massive positive electrons or protons. We are all agreed that radiation may be regarded as an electromagnetic disturbance To complete the picture we are forced by experimental facts to accept the two main postulates of Bohr (1) Atomic systems can exist in certain "stationary states" which may be discussed by help of the ordinary electrodynamics in association with the appropriate quantum restrictions, (2) the passage of the systems between different stationary states cannot be treated by the classical theory, but involves, in some unexplained way, the emission or absorption of an amount of homogeneous radiation defined by the energy quantum $h\nu$, the product of Planck's constant h and the frequency ν. The foundations of the theory are discussed in an able manner in the appendices to the volume under review, and a special word of praise must be given to the lucid account of the "correspondence principle" by Prof James Rice Bohr's first postulate leads directly to the conception of energy levels, each such level being appropriate to a particular arrangement of the constituent charges of atom or molecule It may be well to emphasise the importance of this conception in connexion with the problem of reaction velocity discussed by Marcelin and by Rice The applications of the second postulate described in the volume are many, and it is possible to refer only to two which have recently attracted much attention

The important photo-chemical law formulated by Einstein (1912) may be stated as follows When light of frequency ν is incident on a system sensitive to such light, for each quantum of energy ($h\nu$) absorbed, one molecule of the absorbing substance is decomposed It follows, according to this law, that the amount of substance acted upon by the light is proportional to the product of the absorbed radiant energy and its wave-length, and is independent of all other factors such as temperature Most photo-chemical processes are complicated by secondary reactions which render it extremely difficult to test the direct applicability of the law It is, however, now generally admitted that *the absorbing molecule* absorbs energy in quanta. The experimental evidence is discussed in Appendix VII by R O. Griffith, who concludes that the ratio of the number of molecules decomposed to the number of quanta absorbed may vary over wide limits, though in a large number of cases its value is not far removed from unity In a few reactions and within certain narrow spectral limits the ratio has been found to be unity In the photo-chemical decomposition of hydrobromic and hydriodic acids, one quantum brings about the decomposition of two molecules, one molecule being decomposed directly, the other by a secondary process But, in general, the ratio above mentioned is determined by processes which occur between the act of absorption and the production of the final products Thus the final conclusion reached may be stated by saying that there is strong evidence in favour of the view that the ratio of the energy absorbed to $h\nu$ is equal to the number of absorbing molecules, but this number may differ considerably from the number of molecules decomposed It is, accordingly, extremely probable that the primary process consists in the absorption of an energy quantum, but the subsequent changes are frequently so complicated that it is not at present possible to express them in terms of the quantum theory

The second question of great interest is the radiation hypothesis of chemical change first suggested by Trautz and discussed later by Perrin and the author of the present volume Whilst the hypothesis accounts satisfactorily for the influence of temperature upon the velocity constant, it has not yet been shown that the hypothesis is capable of accounting for a velocity constant itself, the observed velocities being greatly in excess of those required by the hypothesis. Prof. Lewis sums up the position (in 1923) in a very fair way, without coming to any definite conclusion He points out that the true analogue of thermal chemical change

on the radiation hypothesis is the thermionic effect, consisting in the emission of electrons due to the temperature of the material itself, and consequently due to the radiation density of all wave-lengths characteristic of the temperature of the material The analogue of photo-chemical change is the photo-electric effect, in which electrons are emitted from a material owing to exposure of the surface to radiation from an external source at a relatively high temperature and usually of relatively short wave-length

The reviewer has carefully compared the new edition with that of 1919 and finds that not only has the size of the volume been doubled but many desirable alterations and corrections have also been made. There are some points which require correction, but as the author remarks with truth, in such a rapidly changing subject it is exceedingly difficult to carry out the process of selection and condensation in a satisfactory way. Whilst the book cannot be described as a work of the very first rank, no serious student of advanced chemistry or physics can afford to overlook it. H S Allen

Among the Natives of East Africa.

Beneath African Glaciers the Humours, Tragedies, and Demands of an East African Government Station as experienced by an Official's Wife, with some Personal Views on Native Life and Customs By Anne Dundas Pp 238 + 28 plates (London. H F and G. Witherby, 1924.) 12s 6d. net.

Mrs Dundas, as the wife of one of the Chief Commissioners (in the Kilimanjaro district), has had special opportunities for studying native problems on the spot, and these opportunities she has used to the utmost. It is admirable the ease with which she adapts herself to novel surroundings, making the best of everything, seeing something of interest in every place and object, whether at home or on the march. This is no small achievement when one considers the multitude of discomforts which have to be contended with in the climate of equatorial Africa, yet with a mind so active and so fully occupied with all that is going on around her, she is fortunate in having little time to dwell on these matters Her sympathy with the inhabitants, and her power of expressing, in clear and pleasant language, the results of her observations and the conclusions she has come to, add a charm which is not often found in a book of this description Existing and prospective officials, whose fate it may be to govern primitive races, could not do better than study closely what she has to say

It is quite refreshing to read of the unsophisticated life the natives of this country lead—apparently happy—unspoilt, as yet, by the professional agitator, who earns his living by disturbing the "natural true contentment of spirit" in which man lives The chapter on missionaries and their ways, and the conclusions the author comes to, are of much interest because of the important influence they are sometimes able to exert on the destinies of uncivilised people One cannot help thinking that the author's views are sound common sense. What missionaries should do, when they begin to work among primitive races, is to devote all their energies to educating them, without trying to convert them, and without interfering with their native customs, for the latter often has the effect of undermining the authority of their chiefs through whom it is our policy to govern, any interference necessary in this direction should be left to government.

Mrs Dundas puts all this very well, and we must leave it to her readers to see how she does it. We may say, however, that her views appear to be those of a thoughtful inquirer, even on such a delicate subject as polygamy, deserving the closest attention of all who really have the welfare of native races at heart, and we hope her writings will bear some fruit. It is not the first time missionary methods have been criticised, but we are not sure criticism has produced much effect

Mrs Dundas has a good deal to say about Kilimanjaro, Africa's highest mountain, in sight of which she spent so much time Two chapters are devoted to native manners and customs, and one to "big and little game" The book is well illustrated by scenes from life in Tanganyika, but a map is badly wanted, and if the volume is ever reprinted one should certainly be added H L C

Our Bookshelf.

L'Isotopie et les éléments isotopes Par Mme Pierre Curie (Recueil des Conférences-Rapports de Documentation sur la Physique Vol. 9, 2e série, Conférences 1, 2, 3. Édité par la Société *Journal de Physique*) Pp 210. (Paris · Les Presses universitaires de France, 1924) 22 50 francs

The announcement that the first series of reports published under the auspices of the *Journal de Physique* was to be followed by a second series must have been welcomed by many physicists, to whom the task of keeping abreast of the manifold developments of the subject has become of daily increasing difficulty The editors have been fortunate in their choice both of author and subject for this opening volume of the second series. There can be no doubt of the authority with which Mme Curie speaks in all matters radio-active, or of her ability to marshal and expound her facts in a manner which makes them easy to grasp and assimilate The fact that she has not been personally concerned in the more startling of the discoveries which she has to narrate is an additional advantage, as it has enabled her to exercise a critical discrimination not so

easily attained by one more intimately connected with the development of the subject

The present volume is admirable, and covers a considerably wider field than might be expected from its title It opens with an excellent synopsis of the chemistry, electrochemistry, and classification of the radio-elements leading up to a study of the radioactive isotopes. The following section deals with the isotopes of the non-radioactive elements, and the experiments of Aston, Dempster, and others A third brief section is devoted to some interesting speculations on the structure of the atomic nucleus, and the volume concludes with a critical account of the methods adopted or proposed for separating the pure isotopes from the mixed element

A full bibliography is appended Unfortunately, there is no index The book is clearly printed and well illustrated with diagrams and plates, and its value is enhanced by numerous well-displayed tables. Mme Curie has collected in these 210 pages a mine of information, much of which can only be consulted elsewhere in original publications Both physicists and chemists should find this volume a valuable addition to their bookshelves J A. C

Electrical Machinery and Control Diagrams By T Croft Pp. xii + 305 (London McGraw-Hill Publishing Co., Ltd, 1924.) 15*s*. net

IN practice, an electrician sometimes merely requires a circuit diagram of the apparatus or equipment with which he is working He must therefore use symbols to denote electric bells, dynamos, etc, and show how they are connected with the accessory apparatus, such as switches, fuses, and regulating resistance coils It is of importance that standard symbols should be internationally adopted. Considerable progress has been made in this direction by the International Electrotechnical Commission, and the leading countries of the world have sent in suggested symbols Complete agreement, however, has not yet been obtained

The symbols adopted by the author are those used by the Electric Power Club of America They are very similar to those used in other countries The 500 circuit diagrams given cover practically all of the apparatus used in a modern power or super-power electric station The diagrams are of all degrees of complexity, beginning with the simple manually controlled starting rheostat and going on to the automatic substation To the practical engineer they will be helpful We hope that in the second edition of this book the author will be able to adopt international diagrams, and that he will also include diagrams for radio communication circuits

Psychological Tests of Mental Abilities. By Prof A S Woodburne Pp v + 232 (Madras Government Press, 1924) 2 8 rupees

ALTHOUGH the method of mental testing is a comparative innovation in the field of education, its use is already almost ubiquitous Most people know that it is widely employed in Europe and America, but perhaps fewer realise that its use has spread to Japan, China, Turkey, and, as the book under notice shows, to India

Prof. Woodburne was invited last year to give a course of lectures on intelligence tests at the University of Madras, and he has extended his remarks to form a book. The larger part of it is a lucid description of the general principles of testing, and it shows evidence of wide reading and careful discrimination. Ample illustrations are given of the various types of linguistic, performance and vocational tests

Some good work has already been done in India along these lines, and it is interesting to read of the necessary adaptations of standard tests in order to make them suitable for that country. Particularly illuminating also are the investigations of Prof. Haylands and of the author for the purpose of comparing the mental processes of the Indian and English adolescent. Indian educationists are keeping well to the fore in mental testing, for they have already planned a central clearing-house for results, and have suggested adequate instruction in testing methods for all their training college students.

In an Unknown Land By Thomas Gann Pp. 263 + 32 plates. (London Duckworth and Co, 1924) 21*s* net.

THE unknown land of which Mr Gann writes is Yucatan, which he visited with Dr S G Morley for the purposes of archæological investigation From Belize the party went northward and then westward on a two months' trip round the coast, making several inland expeditions to visit ruined Maya cities Incidentally the book contains a great deal of information on a part of Central America that is little known and not easy of access, but its main value is the account the author gives of the Maya ruins and the Santa Cruz Indians These form an independent tribe, since the Mexican government virtually evacuated their province, and represent the purest descendants of the Mayas A great deal of work was accomplished, including visits to Chacmool, a previously unknown ruined city, Tuluum, which has always been difficult to reach owing to Indian hostility, and two minor new discoveries at Cancuen and Playa Carmen All these are fully described Of great interest are the accounts of the remarkable mural paintings of human figures and gods executed in bright colours on a hard stucco, found at Tuluum in a fresh condition despite their age of four centuries The elucidation of the Maya method of dating in Yucatan was another striking discovery

Graphic Statistics in Management By W H. Smith. Pp vii + 360. (London · McGraw-Hill Publishing Co, Ltd, 1924) 20*s* net

THE recording of business activity by graphical means is extending rapidly among the controllers of large businesses, and a book like the present volume, written primarily in the atmosphere of American big business, should be of especial interest in Great Britain The whole subject is treated in picturesque graphical fashion, no mathematical symbol appears anywhere, and yet a considerable degree of analysis of financial and business activity, production, sales, markets, and costing is successfully effected The chapter dealing with graphical statistics in advertising is capital, a large number of illustrations of varying character being shown, including one demonstrating the effect of advertisement on church attendance and Sunday morning offerings!

Letters to the Editor.

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Biographical Byways: Dr. S. P. Langley.

I REGRETTED to see Sir Arthur Schuster's article in NATURE of February 7 presented so unpleasing a picture of my old chief, Dr S P Langley Like some other great men I have met, his character had blemishes, and, as one of Sir Arthur's anecdotes indicates, it was surprising to see in so great a man such care to preserve the appearance of dignity which he thought properly attached to his office and his attainments If he had been as careless of it as Lord Kelvin, dignity would have wrapped itself about him like a cloak, crowned with the mantle of lovableness, which, to his intimates, Langley surely possessed One is reminded of the Scripture saying " He that loveth his life shall lose it "

In regard to the eclipse of July 29, 1878, Sir Arthur Schuster's recollection is contradicted by Langley's own account Prof Cleveland Abbe, indeed, was carried down on account of sickness, but Langley, though at first ill, remained at the summit of Pike's Peak, observed the eclipse, sketched the corona to 12 diameters, and his report and sketch is to be found in the publications of the U S Naval Observatory (Washington Observations, 1876, Pt 2, vol 23, pp 203-10)

As a pioneer, Langley has to his credit the great forward step that he took in the spectral study of the energy of radiation of the sun, the moon, and terrestrially heated bodies He was the founder of modern methods in this branch of science Also, he lent his prestige to rescue from the domain of ridicule the subject of mechanical flight, and investigated at great length, with novel devices, the reactions of moving surfaces in the air On the basis of these experiments he accomplished prolonged steady flight of quarter-sized engine-driven mechanical models, about eight years before the first human flying with power-driven aeroplanes took place Except for bad judgment in shooting his larger machine from a house-boat, instead of allowing it to take off gradually as was proposed, engine-propelled human flight would have been made several years before it actually occurred The blemishes of such a man ought not to blind us to his greatness

I am happy, however, to be able to soften the implication of the final anecdote of Sir Arthur Schuster He got the quotation, I suppose, through several mouths, and it is not accurate When I was about to start on my first expedition to Mount Wilson, in the year 1905, Dr Langley came to my office to talk over the plans Months earlier we had discussed his value of 3 calories for the solar constant, and he was nearly convinced, I believe, that it had been based on an error of logic in the reduction of the Mount Whitney observations Yet he did not desire to publish a retraction, for, as he said, " Mr Abbot, I did that work when I was at the height of my powers Now that I have been long out of the field, I am not more competent than I was then to reason upon it " He paused a moment, and added with a twinkle in his eye " As the witty Frenchman has said, ' What has posterity done for us that we should care so much for the opinion of posterity ? ' "

So, when we finished our interview in April 1905, it was rather in the nature of good-natured chaffing than in the nature of an order when Langley said to me " You will, of course, bear in mind that it is rather the *variation* of the sun that you are going to measure than the absolute value of the solar constant." The twinkle came again into his eye, as he continued " In fact, Mr Abbot, I might add that for me the best value of the solar constant is that which nearest approaches 3 calories ! " and, as he always did when he had said a good thing, he turned quickly and almost ran away It was the last time that I saw Dr Langley alive

C G ABBOT.

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Washington, U S A ,
March 3

Passivity of Iron and other Metals.

IT is well known that the principal metals which show the phenomena of passivity are chromium, manganese, iron, cobalt and nickel These elements have this in common that they form divalent ions, and that while possessing electrons, on Bohr's theory, in the 4th-quantum orbit, their 3rd-quantum orbits are incomplete My view is that these elements when in the active state have each two electrons in the 4th-quantum orbit, and that they become passive when one of these electrons is removed to a 3rd-quantum orbit This implies that the usual chemical and physical agencies which make an active metal passive or a passive one active, merely, in some way, induce these electronic changes It is for the physicists to say if this be possible There is, however, no *a priori* objection to this view since transitions between 3rd- and 4th-quantum orbits of these elements are known to occur readily I do not suppose a suggestion of this kind will explain the whole of the phenomena of passivity, which is admittedly complex, but I offer it as a contribution towards the explanation of the more obvious phenomena

Very few determinations of the electrode potentials of metals in the passive state have been published, and some workers have doubted if such determinations have any significance I have found a simple way of preparing and keeping metals permanently in the passive state, and of comparing their electrode potentials with those of metals which do not show passivity This consists in obtaining metals two at a time in mercury and comparing their powers of reducing solutions in sulphuric acid of uranyl sulphate, ferric sulphate, potassium permanganate and other oxidising agents I find the order of the potentials of the metals in mercury is (proceeding from electro-positive to noble metals and including only those relevant to this discussion) zinc, cadmium, thallium, tin, lead, copper, manganese and iron, bismuth, cobalt, mercury, nickel and platinum The order of these metals seems quite definite It is the same whatever oxidising agent be reduced, whether the solutions be hot or cold, whether sulphuric or hydrochloric acid be employed, and whatever other metals are present in the amalgam The order of potentials of metals in the free state is known to be : manganese, zinc, iron, cadmium, thallium, cobalt, nickel, tin, lead, copper, bismuth, mercury and platinum A comparison of these two lists shows that only the metals known to show passivity fall out of order The simplest inference is that the passive state is a quite definite condition, and that it is produced and maintained when the metal is amalgamated. This is consistent with Lambert's discovery that pure iron is a noble metal when its surface is electrically neutral

The ions of these passive metals, however, do not behave as if they were the ions of noble metals For example, ions of tin, lead and copper, but not of

cobalt, iron or nickel, are easily reduced to the metallic state by zinc amalgam in sulphuric acid solution The order of the ions is probably similar to that of the metals when their electrode potentials are determined in the free state If this be so, it follows that elements which show passivity must have alternative configurations of planetary electrons, one of which corresponds to the configuration possessed by its ion On present knowledge the number of electrons in the atom of iron is 2, 8, 14, 2 in the 1st-, 2nd-, 3rd-, and 4th-quantum orbits respectively, and in the ferrous ion 2, 8, 14, 0 If the latter configuration represents the ferrous ion, the former should represent the active iron because active iron passes readily into the ferrous condition. Passive iron may therefore have one of the configurations 2, 8, 15, 1 ; 2, 8, 13, 3. Similar considerations apply to the metals chromium, manganese, cobalt and nickel When each of these elements has two electrons in the 4th-quantum orbit, it is likely to be in the active state and, when another number of electrons, it is likely to be passive.

I think that this number is probably one because (a) it cannot be less, and (b) the agencies that are known to bring about passivity might possibly force one of the 4th-quantum electrons into a 3rd-quantum orbit This view receives some support from the following nickel is normally passive, that is, it differs from the other elements which show passivity in being rendered passive more easily than active Now, according to Kramers and Holst, the configuration of the electrons in nickel is likely to be 2, 8, 17, 1. This on the views expressed here would represent the passive metal, and the alternative configuration 2, 8, 16, 2, from which the nickel ion is derived, would represent the active

I might add that metals when dissolved in mercury are far more efficient reducers in the presence of sulphuric acid than when in the free state For example, tin, lead and iron are nearly one hundred per cent. efficient when reducing ferric sulphate in sulphuric acid of different strengths, that is to say, these metals go into solution only in so far as it is necessary to bring about the quantitative reduction

A S RUSSELL

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February 21

The Compton and Duane Effects.

THE experimental arrangement used by Compton has been such as to emphasise the fact that the change of wave-length represented by the most intense part of the modified line agrees with the formula

$$\lambda_\phi - \lambda_0 = h \text{ vers } \phi / mc, \quad (1)$$

where λ_ϕ is the wave-length of the X-rays scattered at an angle ϕ and λ_0 is the wave-length of the primary rays. On the other hand, the experimental arrangement used by Duane has until recently been such as to emphasise the fact that very often the modified rays consist of a band of wave-lengths beginning at a wave-length change given by

$$\lambda_\phi - \lambda_0 = \lambda_0^2/(\lambda_s - \lambda_0), \quad (2)$$

where λ_s is a critical absorption wave-length of the scatterer More recently Allison and Duane (*Phys Rev*, 25, 235, 1925) by using smaller scattering blocks have found an agreement with (1), although they remark that there is a band of wave-lengths about this value This band nature of the wave-length change is also evident in Compton's curves (*Phys Rev*, 22, 409, 1923) Some of the width of the band is due to the variation of ϕ in (1), but when the width due to this cause is subtracted from the width shown in Compton's curves, there is still some excess width The writer has been able to explain this excess width by taking into account the momentum of the scattering electrons in their Bohr orbits (*Phil Mag*, in print) The electrons are moving in all sorts of directions, and hence we get a wave-length change varying from a minimum to a maximum, the width depending on the magnitude of the momentum of the electrons.

More recently, the writer (*Phys. Rev*, in print) has been able to show that, if the binding energy is above a certain amount, and therefore the momentum of the scattering electrons above a certain other amount, the width given by taking into account the momentum of the scattering electrons alone is such that the minimum change of wave-length is less than that given by (2) However, the least possible change of wave-length is given by (2), because the recoil electron must be given sufficient energy to overcome its binding energy to the atom in order to be ejected If the energy given to the electron by the scattering process is less than this, then the electron cannot be ejected from its Bohr orbit, and we may suppose that the mass of the rest of the atom is added to that of the electron This causes m in (1) to be large, with the result that the change of wave-length is negligible.

Hence we have a quantum theory explanation of the existence of the unmodified line Whenever there is an unmodified line produced by the scattering of X-rays by electrons of a certain type (*K*, *L*, etc), then the wave-length change of the beginning of the modified band is given by (2) For example, when Mo$K\alpha$ X-rays are scattered at 90° by the K electrons of carbon, the modified band begins at a wave-length change of 0 012 Å U and extends to 0 057 Å U The short wave-length limit of the modified band is in this case independent of the angle of scattering, which is in agreement with Duane's earlier experiments The long wave-length limit, however, depends upon the angle of scattering Duane in these earlier experiments used a large scattering block, so that there was considerable variation of the scattering angle ϕ This variation of ϕ causes a variation in the long wave-length limit of the modified band, but not in the short wave-length limit The theory indicates that with a given value of ϕ the intensity is approximately the same all over the modified band Hence with a large variation of ϕ the intensity would be greatest at the short wave-length limit of the band This is the result observed by Duane

The above is an explanation of Duane's results with a large scattering block Compton, however, finds for $\phi = 90°$ that the wave-length change of the most intense part of the modified band is 0 0242 Å U Compton used a smaller scattering block and a spectrometer of less resolving power than Duane With a small scatterer, the modified band would still extend from $\lambda_\phi - \lambda_0 = 0\ 012$ to $\lambda_\phi - \lambda_0 = 0\ 057$ Å U. for the scattering of Mo$K\alpha$ X-rays by the K electrons of carbon However, there are also L electrons in carbon Of these the *L III* electrons move in circular orbits, and these *L III* electrons produce a modified band extending from $\lambda_\phi - \lambda_0 = 0\ 0185$ Å U to $\lambda_\phi - \lambda_0 = 0\ 030$ Å U The band does not in this case extend from the value of $\lambda_\phi - \lambda_0$ given by (2), and hence there are no unmodified rays scattered by the *L III* electrons at 90° The centre of the modified band is seen to be at 0 0242 Å U, the value given by (1) The *L III* band will be superposed on the K band, but the former will stand out more strongly since the theory indicates that the intensity (*i e.* the energy per unit wave-length width) of the *L III* band is greater than that of the K band

Hence, when a small scatterer is used the modified band shows great intensity at 0·0242 Å.U The centre of this intense portion and its width depend, however, on ϕ Hence for a large scatterer the intense portion becomes indistinct Further, for a large variation of ϕ, the theory shows that the most intense part of the band due to the $L\ III$ electrons is displaced to the short wave-length side of the value obtained by putting the average value of ϕ in (1). Large scatterers, therefore, tend to obscure the existence of the Compton wave-length change

Still further, a spectrometer of low resolving power will show the Compton wave-length change better than one of high resolving power With low resolving power the most intense part of the band comes at 0 0242 Å U for $\phi=90°$, whereas with high resolving power the band character of the modified rays is emphasised. For example, with high resolving power the $K\alpha_1$ and $K\alpha_2$ lines of molybdenum can be separated in the unmodified line, while the modified band will show no such separation, as each modified band overlaps the other due to its width The absence of separation in the modified band might cause an experimenter using high resolving power to doubt the existence of the Compton effect

G E M JAUNCEY

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February 14.

Transmission of Stimuli in Plants.

NATURE of January 17 has just reached me and I hasten to send a reply to Mr Snow's letter on this subject I repeat once more that in the numerous experiments which I carried out with the stem of *Mimosa pudica*, the stimulus was never transmitted across the water gap Mr Snow repudiates the idea that he has disagreed with my conclusions in regard to the conduction in the petiole of Mimosa "Actually, however," he says in his letter, "in agreement with him [Sir J C Bose] I have produced evidence to show that in the leaf, excitation is conducted in the phloem and has nothing to do with the transpiration current I agree also that this conduction in the leaf is, in all probability, a true physiological process, and consider that Sir J C Bose's experiments on the petiole, which so strongly support this view, are of very great value In the stem, however, as I found, this conduction in the phloem either fails completely, or at least is regularly too weak to cause the leaves to fall"

Since it is admitted that conduction does not take place across a water gap in the petiole, Mr Snow will note that there is a serious breach of continuity in the assumption that the mechanism of conduction in the stem is widely different from that in the petiole. We stimulate the leaf, excitation is transmitted along the phloem in the petiole and overflows into the stem, causing the successive fall of the leaves Where does the hiatus in the conducting mechanism come in? The supposed conduction across a water gap in the stem has led to the theory that the transpiration current in the wood is the means of conduction of excitation But the observation of Mr Snow himself does not support this theory, for he finds, in opposition to Prof Dixon, that Dr Ricca's theory of the transpiration current is inadequate "to cover *all* the phenomena of conduction in Mimosa, including conduction in the leaf and the subordinate phenomenon of 'high-speed' conduction in the stem"

In my "Physiology of the Ascent of Sap" (1923), p 269, I have clearly explained the modes of intercommunication and interaction between more or less distant organs of a plant "This is accomplished in two different ways, by *transfer of matter* and by *transmission of motion* The first is exemplified by hydraulic convection of liquids carrying chemical substances in solution, such as occurs in the circulation of sap, the second, in the conduction of excitatory change along nerves" These two can be easily distinguished from each other from the fact that the conduction of excitation is from a hundred to a thousand times quicker than the sap-movement of the transpiration current A very simple experiment which requires no apparatus is to put a drop of hydrochloric acid on the tip of a leaf of *Mimosa pudica*. the acid remains practically localised, but the protoplasmic excitation induced by it is transmitted with considerable velocity, causing the fall of numerous leaves both above and below This experiment, which can be repeated without any difficulty, completely demolishes the theory of the transpiration current

I have, as stated in my previous letter, carried out numerous crucial experiments which fully establish the nervous character of the transmitted impulse in Mimosa It has been a matter of surprise to me that reference to my work has been omitted in all letters and articles on transmission of stimulus in Mimosa that have appeared in NATURE during the last year This could not have been due to the obscurity of the journal in which my results appeared, for they were published in the Proceedings and Transactions of the Royal Society The omission appears to me to be very curious, it cannot but obscure truth and thus divert the energy of workers in wrong directions which lead nowhere

In this short communication I can make but bare mention of only a few of the results which I have recently obtained The anatomical structure of the nervous tissue, made clear by selective staining of microscopic sections, has been found to be in every way the same in the petiole and in the stem The distribution of the nervous tissue in the whole plant has been clearly traced, affording the fullest explanation of the transmission of excitatory impulse up and down and across the stem. The innervation of the contractile pulvinus, which functions as a muscle, has also been fully investigated, making possible a rational explanation of the purposeful movements by which the leaf places itself so as to absorb the largest amount of radiant energy Still more striking is the success of my efforts to obtain, by means of selective staining, a definite outline of the rapidly contracting tissue in the pulvinus of *Mimosa pudica* No such staining occurs in the slowly reacting pulvini of other plants. This characteristic denotes the possession of a specific catabolic substance, and is highly significant These and other results prove that a very high and quite unexpected degree of differentiation has been reached in the nervous system of Mimosa I am in hopes of early publication of these results. In case of unforeseen delay, I shall take the opportunity of sending a short account of them for publication in NATURE

J C. BOSE.

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February 12

The Behaviour of Crystals and Lenses of Fats on the Surface of Water.

DURING the last two years we have been interested in examining the behaviour of crystals and liquid lenses of fatty acids and esters when placed upon the surface of water.

Sir W B Hardy was the first to observe that the magnitudes of the surface tensions of the various

bounding interfaces for liquids, such as oleic acid, which spreads upon water, were in accordance with the theorem of Dupré,

$$\sigma_{H_2O} > \sigma_{Oil} + \sigma_{Oil\ water}$$

A lens of oleic acid, when placed upon a water surface of limited area, does not extend as a thin lamina of oil in bulk, but as a unimolecular film, by a process of two-dimensional solution or evaporation from the edges of the lens Equilibrium between lens and unimolecular oil film is finally attained when the rate of this process of surface solution or evaporation is balanced by the reverse process of condensation of oil molecules from the film The surface pressure of the film when equilibrium is established is defined by the equation—

$$\sigma_{\text{Contaminated surface.}} = \sigma_{Oil} + \sigma_{Oil\ water}$$

We have noted that solid fatty acids and esters will spread on water surfaces until the surface tension of the water falls to a definite equilibrium value, but the rate of spread is much slower than for liquids

The beautiful experiments of Mr Adam have re-

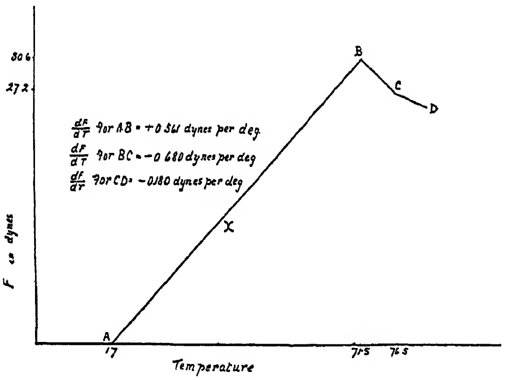

FIG 1

vealed the interesting fact that surface films may exist in two forms, the condensed and the expanded, the former being the two-dimensional prototype of solids and liquids, the latter of vapour Both crystals and liquid lenses can exist in equilibrium with both these condensed and expanded films, the equilibrium pressures being naturally different for each phase, and varying in a marked manner with the temperature, similar to the three-dimensional phase properties of solubility and vapour pressure

Fig 1 represents a typical F T curve for stearic acid, in which this equilibrium two-dimensional pressure in dynes per cm is plotted as a function of the temperature

Along the line AB the film in equilibrium with the solid crystal is condensed, the superficial melting-point of the film being at x At B the crystal melts, and the curve BC represents the variation with the temperature of the condensed film in equilibrium with a lens of the liquid acid At the third non-variant point C the condensed film expands, and the curve CD represents the temperature variation of the two-dimensional expanded film in equilibrium with the liquid lens

As in the case of three-dimensional phase equilibria, it is possible to calculate the various latent heats associated with the changes of the bulk solid and liquid into the two-dimensional condensed and expanded modifications We may apply a modified equation of the type suggested by Clapeyron,

$$\frac{dF}{dT} = \frac{L}{T(A_2 - A_1)},$$

where A_2 is the area of the film, A_1 the area of the acid in bulk, T the temperature, and L the latent heat of the change in question From the curve AB we obtain 5860 calories as the latent heat of transformation of the acid from the bulk solid to the condensed film, at the point B From BC we obtain −6840 calories as the latent heat of change of the bulk liquid into the condensed film at the point B From these two values we obtain 12,700 calories as the latent heat of fusion of stearic acid, a value in reasonably good agreement with 13,500 cited in Landolt Bornstein

In a similar manner, the other latent heats of transformation may readily be calculated, although the actual area of the molecules in the expanded state cannot be computed so accurately as for condensed films

Through the kindness of Mr N K Adam and Dr. Garner a number of organic acids and esters in a highly purified state have been placed at our disposal, and we have succeeded in obtaining a number of these F T curves and in making similar calculations from the data so obtained We hope to publish these data *in extenso* in the near future, as soon as certain corrections necessitated by the use of the ring method have been accurately determined

A P CARY,
ERIC K RIDEAL.

Laboratory of Physical Chemistry,
Cambridge, March 6

Ectodermal Muscles in a Crustacean.

THE generally accepted view as to the origin of the musculature of the Crustacea is that it is derived from the mesoderm In Chirocephalus, while the majority of the muscles arise from the mesoderm, there are others that are definitely of ectodermal origin The dilator muscles of the proctodæum are examples of this type, and probably with these should be classed the dilator muscles of the œsophagus. At the most posterior tip of the body, where the ectoderm folds inwards to form the proctodæal tube, the formation of the dilator muscles can be seen most clearly Certain ectodermal cells in this region elongate and then, while retaining one end in the outer ectoderm, the other passes inwards with the invaginating ectoderm This passage inwards is probably not an active migration, but is brought about by the proliferation of the surrounding cells, the latter pushing in between the two ends of the muscle cell. In the elongating cell body one or two fibrils appear that very early divide into segments, giving the typical structure of striped muscle The final muscle is thus an elongated cell, attached at its inner end directly to the cuticle lining the proctodæum and at the other end to the external cuticle

A more interesting set of ectodermal muscles is to be found in the trunk region In this region the limbs appear at first as a series of pouch-like outgrowths and, as a result of this development, the ectoderm in between them forms a series of ventro-lateral ridges projecting into the body cavity As the limb rudiments enlarge, the inner edges of these ridges become nipped off from the more lateral ectoderm In this way a string of cells is formed on either side in each intersegmental plane, running from the mid-ventral line to the dorso-lateral ectoderm Deeply staining fibrils appear in them

almost at once. These spread out dorsally into a fan and, running between the nuclei of the superficial ectodermal cells, end directly against the cuticle. Ventrally they terminate in a narrow bundle against the cuticle of the mid-ventral line. For a considerable time no change other than growth takes place, but ultimately, at the dorsal end, at the level of the inner face of the surrounding ectoderm cells, the fibrils lose their staining capacity and become replaced by a tendinous plate. Below this plate the fibrils now divide into segments converting the strings of cells into typical striped muscles. Above it they persist as a radiating series of "tendo-fibrils," showing no signs of segmentation and ending directly against the cuticle.

On the outer side of this series is another set of muscles having the same median ventral attachment, but having an upper attachment just below—that is, more lateral to that of the first series. These are also entirely ectodermal in origin, and are formed in the same way as the first series.

The important facts that emerge from this development are, first, that certain muscles of the Crustacea are definitely ectodermal in origin, a fact not at all in conflict with what might be deduced from the ancestry of the group, and, secondly, that the "tendo-fibrils" that run from the cuticle through the ectoderm cells to attach to endoskeletal structures may be the remains of the same originally continuous fibrils that divide up elsewhere to give the myofibrils of typical striped muscle.

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On the Absorption Spectrum of Aluminium.

IT is well known that the study of the absorption spectrum of elements provides us with the simplest method of determining the normal states of atoms. In the hands of Wood, Bevan, McLennan, and others, the study of the absorption spectrum corroborated that in the case of elements of the first and the second groups, the normal orbits are those designated spectroscopically as $1s$ and $1S$ respectively.

In the case of elements of higher groups, the experiments become more difficult, as most of them have high boiling-points, so that with the furnaces which can be commanded in a physical laboratory, very little vapour can be obtained for absorption work. This difficulty becomes more acute in the case of metals of the third group, all of which, excepting thallium, yield very little vapour up to temperatures of 1200° C., and, in fact, we are not aware that any successful experiment has been done on the absorption spectrum of aluminium and boron, which are the least volatile elements of this group. At the same time, such experiments are necessary for determining once for all whether for these elements the $2p_1$ orbit is the normal stage, as has been obtained from the analysis of their arc spectra and corroborated by the absorption experiments in the case of indium, gallium, and thallium.

We have recently carried out successfully the absorption experiment with aluminium, using the vacuum furnace designed by Prof. Meghnad Saha for ionisation work. The furnace consists of an Acheson graphite tube heated by a battery of accumulators. The temperature was simultaneously measured by a Wanner pyrometer. We used a cadmium spark, and a copper spark under water as our sources of continuous light. The spectrum was photographed on Ilford ordinary plates sensitised by nujol, as described by Lyman. We found that no aluminium lines are obtained below 1500° C. At 1520° C., the pair $\lambda = 3961, 3944$ come out reversed. At 1650° C., the leading members of $2p_i - md$ series come out reversed. The higher members of $2p_i - ms$ series require a little higher temperature. Another curious feature is that on all plates the $2p_i - ms$ lines and $2p - md$ lines of gallium occur rather prominently. Apparently gallium occurs as an impurity in ordinary samples of aluminium.

From such experiments it is not possible to deduce whether for aluminium the $2p$- orbits are the normal orbits, or whether there is a still larger $1s$ orbit. For at the temperature at which sufficient vapour is available for absorption work, the thermal stimulus is quite sufficient to convert any lower $1s$ orbit to the $2p$- orbits. The vapour pressure of aluminium is evidently very low even at 1520° C., but we could not find any existing data on the subject, except some theoretical considerations by Gruneisen. Our apparatus is suited to the determination of vapour pressure of aluminium over a large range of temperature by using the so-called *Mitfuhrungs-methode* of Pfaundler, and we hope to carry it out at an early date. At any rate, it is quite clear that the $2p - mx$ lines require a lot of vapour for absorption, and if the $2p$- orbits turn out to be the normal orbits of aluminium atom, they do not dominate the spectrum to the same extent as the $1s$ orbits of alkalies dominate their spectra.

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The Origin of Sponge-spicules.

IT is to be regretted that Dr. Bidder (NATURE, February 28), before publishing his criticisms of my theory of the symbiotic origin of sponge-spicules, did not await the publication of the detailed evidence upon which that theory is based. I am loth to enter into controversy with him, but as his letter contains much that is misleading, I feel that I can scarcely pass it over in silence. He speaks of the observation (presumably mine) "that the first rudiment of the spicule in Stelletta is a skeleton-crystal on the tetrahedral system." I made no such observation. On the contrary, I endeavoured to show by observations on the silica pearls that the first rudiment is a minute granule resembling a Micrococcus.

Dr. Bidder's "crystallographic explanation," so far as siliceous sponges are concerned, appears to rest on the assumption that the protorhabd, or axial thread, is itself composed of silica. Otherwise it would be difficult to understand his "conjecture" as to the variation of the type of crystallisation with the percentage of water in the "spicopal." His supposed "skeleton-crystal" can be nothing but the radiating axial threads. He admits that the silica afterwards deposited upon it is "in amorphous aggregation." Unfortunately, the best observers, such as Butschli and Schulze, are in agreement that the axial thread is composed of a protein substance, and there is nothing else that could form the siliceous skeleton-crystal which he imagines to exist. The statement that my scleroplastids "are at first gelatinous but become crystalline" is pure invention. It is well known that the axial thread, formed, as I believe, by elongation of the scleroplastid, retains its original "organic" character in the axial canal of the fully formed spicule, and, so far as I am aware, no one has hitherto ventured to suggest that it becomes crystalline.

Dr. Bidder accuses me of having "strangely changed" the name of a certain sponge to Donatia. If he will study the literature of the subject he will

find that this is the name now generally given by spongologists to the genus in question, and for very good reasons I have merely followed precedent, and in any case I fail to see what the nomenclature of this genus has to do with the question at issue

What Dr Bidder means by saying that the Suberitidæ have triaxon spicules I do not know. I can only say that Suberites has not In his reference to the "innumerable 'species' of sponges which infest our books," he seems anxious to belittle the work of "classifiers," but if he would pay more attention to this work he might perhaps come to realise that it has plainly demonstrated that sponge-spicules, like other organic products, have a long evolutionary history behind them, that they can be arranged in evolutionary series, and that in their individual development they may actually recapitulate their ancestral history It is perfectly useless for any one to attempt to discuss this subject merely on the basis of acquaintance with a few of the simpler spicule forms.

ARTHUR DENDY
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March 3

The Action of Silica on Electrolytes.

THE questions raised in Prof Mukherjee's letter of January 31 are so important that I should like to reply briefly.

(1) I have not found any reason to depart from the views expressed in our paper in the Transactions of the Chemical Society (T. 1923, 123, 2027) that pure silica does not exhibit any absorbing or reacting power towards acids I have made experiments with commercial "silica gel" and N/500 hydrochloric acid, and at first obtained an indication of absorption, but soon found that this was due to some impurity, as the specific resistance of distilled water was lowered from 500,000 to 35,000 ohms on addition of the gel It was therefore purified by washing once with hydrochloric acid and then repeatedly with water until the specific resistance rose to 350,000 ohms, and finally dried and heated to 180° After this treatment, no absorption of acid could be observed, the P_H of the acid being the same (2 69) before and after the addition of 10 per cent of the gel An experiment with oxalic acid, using gel which had been purified with nitric acid, also gave a negative result

(2) It is not clear how previous treatment with acid can destroy any absorbing properties that silica possesses, and I presume that Prof Mukherjee's hydrated substance comes in contact with acid at some stage of its preparation However, to make sure, the gel purified with hydrochloric acid was fused with sodium carbonate and the residue tested with silver nitrate, no chloride could be detected

(3) I do not quite see Prof Mukherjee's difficulty in understanding the experiment in which we found that, whilst pure silica reduced the P_H of sodium chloride solution to 3 96, the impure silica (which contained alkali) only did so to 5·55 The concentration of the silica suspension used was 20 grams per litre, and it seems quite reasonable that 20 grams of an impure alkaline material should neutralise 10^{-4} grams of hydrogen-ions

(4) In this connexion I may point out that the hydrogen-ion concentration of a weak acid solution (*e g* N/5000 hydrochloric acid) falls to about half its calculated value when left for a few minutes in an ordinary glass vessel No change is observed if the vessel is coated internally with paraffin wax or is made of silica. Filter papers also must be used with caution, as all those tried change the specific resistance and P_H of distilled water

This problem is of great interest to us, and if Prof. Mukherjee could at any time spare a small quantity of his pure hydrated silica, we should very much like to make experiments with it

A F JOSEPH
Wellcome Tropical Research Laboratories,
Khartoum, February 21.

The Reported Anti-Relativity Experiment.

UNFORTUNATELY, owing to travelling delays, a modified proof of my response to an editorial inquiry (appearing in NATURE of March 21, p 433, col 1) did not reach the printers in time The experiment reported as having been attempted by Prof Michelson and Dr. Silberstein can scarcely have been conducted in water, though water-pipes were used It may probably be conveniently regarded as a large-scale reproduction of an experiment by an Italian professor who inverted my whirling disk experiment on ether (Phil Trans, 1893) by mounting the whole of the apparatus on a turn-table, including source of light and receiving camera, and looking for a shift of interference bands photographically In the experiment now reported the turn-table was apparently replaced by the earth I suggested such an experiment on p 151, vol 189, of the Phil Trans for 1897 If, as is probable, a positive effect can ultimately be securely demonstrated, it will be for relativists to say whether their position is at all affected, or whether the loophole—that rotation is exceptional, because in rotation matter is moving oppositely on opposite sides of the axis—is acceptable.

It may be convenient to reproduce the passage from Phil Trans, 1897, referred to above

"It is to be observed that since a motion of the disks relatively to the observer and the light causes no effect, the ether being stationary, it follows that a motion of the light and observer would produce an effect, since they would be moving relatively to the ether Hence if, instead of spinning only the disks, the whole apparatus, lantern, optical frame, telescope, observer and all were mounted on a turn-table and caused to rotate, a reversible shift of the bands should be seen My present optical apparatus mounted on a turn-table revolving 4 times a minute should show something, viz $\frac{1}{100}$th band shift each way If the ether is stationary near the earth, that is, if it be neither carried round nor along by that body, then a single interference square, 1 kilometre in the side, would show a shift of rather more than one band width, due to the earth's rotation in these latitudes (see p 772, Phil Trans, 1893)

"But as the effect depends on the area of the square, a size of frame capable of mechanical inversion is altogether too small; there may, however, be some indirect ingenious way of virtually accomplishing a reversal of rotation—something, for instance, based on an interchange of source and eye—and if so, it would constitute the easiest plan of examining into the question of terrestrial ether drift"

OLIVER LODGE

The Glow of Phosphorus.

THE process of the slow luminous oxidation of phosphorus presents anomalies which are still incompletely understood Thus, the non-occurrence of a glow in pure oxygen until the pressure is reduced to about 500 mm of mercury, or an equivalent dilution with an inert gas is made, is very striking No less difficult to explain is the ability of traces of certain vapours to inhibit the luminosity. These

features are also exhibited in the slow oxidation of phosphorus trioxide, and it has been suggested that the phenomena of the glow of phosphorus are due to the trioxide formed in a preliminary non-luminous oxidation. Again, phosphine does not react with oxygen at ordinary pressures, but on reducing the pressure an explosion occurs

With the view of elucidating these difficulties the nature of the light emitted in these oxidations is being studied spectroscopically It was recently shown (Emeléus and Downey, J C S Trans 125, 2491, 1924) that the light from glowing phosphorus, and that from the element burning normally, give the same spectrum This is continuous in the visible region, and has five bands in the ultra-violet between $\lambda = 2370$ Å U and $\lambda = 3290$ Å U These observations have now been extended with the following results the light from glowing phosphorus trioxide, and from spontaneously inflammable phosphine burning in oxygen, give this same spectrum In the first case the strongest three of the five ultra-violet bands have already been identified There is little doubt that the remaining bands will be shown on lengthening the exposure In the second case all five bands have been observed, in addition to bands generally attributed to water at about $\lambda = 3060$ Å U and $\lambda = 2800$ Å U

The fact that the light from glowing phosphorus and that from phosphorus trioxide both give the same spectrum supports the analogy between these two oxidations, already well established in other respects These observations, however, cannot be taken as proof of the identity of the chemical processes They indicate rather that there is some radiating system involved in them all, which gives rise to a definite band spectrum Such a system may well have a connexion with the chemical anomalies common to the low temperature oxidation of these phosphorus compounds H J EMELÉUS

Chemistry Department,
Imperial College of Science and Technology,
London, S W 7, March 4

The Structure of the Mercury Line 2536

AN investigation of the fine structure of the 2536 line of mercury has just been completed as a preliminary to the continuation of the work on the controlled orbital transfers of electrons in optically excited mercury vapour described recently in the Proceedings of the Royal Society It has been found that the structure photographed by Prof. Nagaoka is not the true structure at all, but an absorption spectrum, or perhaps more exactly a structure caused by the self reversal of the true components, resulting from the circumstance that he worked with an Arons-Lummer type of lamp, in which the light of the arc is obliged to pass out through a column of non-luminous mercury vapour, before entering the interference spectroscope

The true structure has been observed with a water-cooled vertical quartz mercury arc, the discharge being pressed against the wall of the tube adjacent to the spectroscopic train by a very weak magnetic field There are five components of uniform intensity, four at sensibly equal intervals, the fifth having a slightly greater separation The observations were made by two quartz Lummer-Gehrke plates crossed in the usual manner On passing the light through a cell 1 cm in thickness containing mercury vapour in vacuo at room temperature, each one of the interference points doubles by reversal and we have a row of ten dots On increasing the thickness of the absorbing layer some of these coalesce, and we end up with a structure sensibly the same as that described and figured by Nagaoka: I say "sensibly" as there appears to be a slight difference between the absorption of mercury vapour in a separate cell, and that of the vapour in the neck of the Arons lamp, which is in a state of ionisation from its contact with the arc. The effect of magnetic fields on the components has also been studied. R W WOOD

Johns Hopkins University, Baltimore

Les rayons γ de haute énergie et leur effet photoélectrique.

DANS une lettre récente à la NATURE (Feb 14, p 226) Mr D H Black attire l'attention sur un rayon γ du thorium B d'énergie élevée Son interprétation dans le spectre naturel indique sa conversion en rayon β par son action sur les niveaux K et L d'un élément de nombre atomique 82 ou 83

Ces faits sont à rapprocher de ceux que M Jean Thibaud a signalés il y a quelque temps (*Comptes rendus*, tome 178, 1924, p 1706, tome 179, 1924, pp 165, 815, 1052, 1322) M Thibaud travaillant dans mon laboratoire a pu obtenir les spectres excités photoélectriquement par des rayons γ dans les éléments les plus divers, il a montré qu'on observait la conversion de rayons γ de près de deux millions de volts sur les niveaux K et L d'atomes lourds (uranium, plomb, platine, tungstène). En particulier un rayon γ de 1,775,000 volts, émis par le radium C, se convertit sur des niveaux L, d'énergie *140 fois moindre*

L'effet photoélectrique des rayons γ de haute énergie se produit avec une intensité remarquable sur les niveaux K d'éléments plus légers, tels que le cerium, l'antimoine, l'étain, l'argent et même le cuivre et le fer

M Jean Thibaud a vérifié très exactement, en étudiant le déplacement des diverses raies photoélectriques lorsque l'on fait varier le nombre atomique du "radiateur" secondaire, que la relation quantique d'Einstein était aussi bien valable pour les quanta très élevés que pour les plus faibles Il a montré enfin l'identité des spectres β naturels et des spectres β excités pour Ra B+C, Th B+C+C″, Ms Th 2 et confirmé ainsi l'origine secondaire des spectres naturels de ces éléments M. DE BROGLIE.

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Radio Reception on Frame Aerials.

I WAS much interested in Mr Cowper's letter in NATURE of February 21 on radio reception on frame aerials For some time I have been quite sure that the usual estimates of probable signal strengths are much too low

On a four-valve (1 H F Det 2 L F) it is possible, on a roughly constructed frame 16 inches square, of 30 D C.C, to receive all B B C stations at loud-speaker strength The tuning is very acute, and, as Mr Cowper mentions, with special arrangements for reaction control This was with B T H B 5 (0 06) valves. I have never tried for American stations, but have no doubt they could be heard.

The station was on the south side of a sheltered valley and the apparatus about 6-8 ft above the ground. The first station I ever heard was Manchester, so loudly that, until the announcer gave the name, I was quite sure it was either Plymouth, 25 miles, or Bournemouth, 90 miles, distant D M ELY.

The School House,
Kingsbridge, Devon.

N 2

The Rotor Ship and Aeronautics.

By Prof. L BAIRSTOW, F R S

THE conversion by Herr Anton Flettner of the sailing ship *Buckau* into a rotor ship was referred to in NATURE of November 22, p. 758, and brief reference was then made to the principles underlying the new proposal for ship propulsion. Since then, details of experiments in wind channels have appeared from which estimates may be made of the forces on rotating cylinders and the power needed to drive them.

Experiments at Gottingen, and the underlying theory, are described by Prof L. Prandtl in *Die Naturwissenschaften* for February 6, whilst the same material is the basis of a small booklet, "Das Rotorschiff und seine physikalischen Grundlagen," by J. Ackeret [1] Both these publications contain a bibliography, the earliest reference being to a paper by B Robins in 1842 (London). Owing to the importance of his investigations, the effect on which the rotor ship depends is spoken of as the "Magnus effect," and is described in a paper published in 1852 in connexion with artillery investigations. Lord Rayleigh's paper of 1877 "on the irregular flight of a tennis ball" deals with the same mathematical theory. Tests for the American National Advisory Committee for Aeronautics have been made and the results published in Technical Note No. 209, a very full abstract of which appears in the issue of *Flight* for January 8, 1925.

The analysis underlying the use of rotating cylinders for rotor ships is the classical hydrodynamical theory to be found in standard treatises [2] In the application, certain approximations are made and there is some lack of agreement between calculation and observation corresponding with them The most important assumption is that which supposes the effects of viscosity in a real fluid to be confined to a thin layer on the surface of the cylinder and that, outside this boundary layer, air behaves as an inviscid fluid The general theory of the boundary layer as given by Prandtl shows it to be thinner and thinner as the speed and size increase and as the viscosity decreases. The exact criterion is a "Reynold's number." For a non-rotating cylinder this "Reynold's" number is Vr/ν, where V is the forward speed of the cylinder, r its radius, and ν the kinematic coefficient of viscosity. When the cylinder is rotating with a circumferential velocity U there will be a separate "Reynold's number" for each value of the ratio U/V.

Any one acquainted with the flow of air or water past bluff obstacles will be aware of the fact that eddies form in their wake and that there is a region of stagnant fluid which does not conform to the hypothesis that the boundary layer is thin, and in fact the classical hydrodynamics is wholly inapplicable to a non-rotary cylinder The streamlines as calculated are shown in Fig. 1, and give a motion for which there is no force on the cylinder in any direction. The flow round a cylinder in a real fluid differs very greatly from that shown behind the section BB′

Rotation of a cylinder in stationary fluid produces circulation Viscosity is called into play to ensure the transmission of the motion of the cylinder to the fluid in contact with it, but in all other respects viscosity is ignored The resulting streamlines are circles concentric with the cylinder, the velocity in them being inversely proportional to the distance from the centre of the circle

By superposition on the well-known lines of Clerk

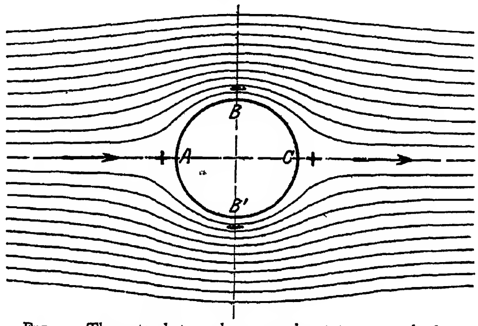

FIG 1 —Theoretical streamlines round a stationary cylinder Reproduced by courtesy of *Die Naturwissenschaften*

Maxwell and others, it is easy to combine the flow shown in Fig 1 with a circulation of any amount, and the result is shown in Fig 2 The circulation has produced lack of symmetry above and below a horizontal line through the centre of the cylinder, but has not disturbed symmetry about the line BB′. By an application of Bernoulli's theorem it may be deduced that there is a force along BB′ but none at right angles

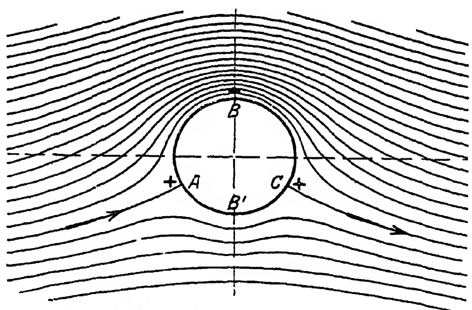

FIG 2 —Theoretical streamlines round a rotating cylinder Reproduced by courtesy of *Die Naturwissenschaften*

to it Bernoulli's theorem as applied to an inviscid fluid gives a relation between pressure, velocity, and density, which shows that high velocity is associated with low pressure, and vice versa. Above the cylinder, at B, the streamlines are close together, and since the same amount of fluid passes between any two consecutive lines, the velocity is high and the pressure low Similarly the pressure at B′ is high.

The general theory of inviscid flow with circulation leads to the formula

Lift ≡ Force across the direction of motion $= \rho VU 2\pi r l$, where ρ is the density of the fluid, V, U, and r have

[1] "Das Rotorschiff und seine physikalischen Grundlagen" Von J Ackeret. Pp. 48+7 Tafeln (Göttingen Vandenhoeck und Ruprecht, 1925) 1 80 gold marks

[2] "Hydrodynamics," Lamb, Articles 68 and 69

already been defined, and l is the length of the cylinder. Strictly speaking, l should be the length of that part of an infinite cylinder on which the force is measured, but it appears from experiment that a cylinder of moderate ratio of length to diameter can be used if discs of double diameter are attached to the ends, a circulation is then obtained which is equivalent to that on a cylinder of indefinite length

As the speed of rotation increases, the streamlines change their character progressively up to a limit When the circumferential velocity is twice the velocity, a limit is reached to the value of the lift divided by ρUV, and in aeronautical language this leads to a limiting value of the lift coefficient defined as

$$\text{Lift coeff}, \textit{i e } k_L = \frac{\text{Lift}}{\rho V^2 \times \text{projected area of cylinder}}.$$

This limit, or maximum lift coefficient, is 2π The quantity is important, because the loading of an aeroplane per unit area of surface at a given speed is proportional to k_L or, conversely, for a given loading the landing speed is inversely proportional to the square root of k_L (max.).

The more efficient aeroplane wings of the day have a maximum lift coefficient of about 0 6 and may reach 0 85; by introducing a number of slots Mr. Handley Page has obtained the highest values known, about 2·0. From figures at Gottingen given by Ackeret, it appears that the maximum lift coefficient for a sail is about 0·4 All these values are much below the theoretical value of 2π, *i.e.* 6 28 Making allowance for partial failure of the theory, it still remains true that the loading per unit area of a rotor cylinder may be ten times as great as that on a sail and several times as great as that on any aeroplane wing in use

It may be of interest to point out the existence of a conformal transformation by Joukowsky by means of which the circle of Fig 2 can be transformed into a section very like that of an aeroplane wing. Experiments at the National Physical Laboratory have shown that such a transformation gives a passable representation of facts but that the lift is overestimated by 25-30 per cent A circulation has been shown to exist of exactly the right amount to explain the measured—as distinct from the calculated—lift An aeroplane wing, therefore, is able to produce circulation without any movement of its surface corresponding with the rotation of the cylinder. The transformation is important in its aeronautical aspects, but the numerous points of interest which arise cannot be further discussed here

It is interesting to see how far the predictions of this partial theory are borne out in practice. In some respects there is a considerable divergence between German and American results, and a suspicion that the experiments in the wind channels have not yet been carried out on a scale large enough to reach limiting conditions The doubts chiefly affect the resistance.

In the American tests, smoke jets were used to indicate the flow of air, and Fig 3 shows how rotation of the cylinder (clockwise) deflects the air The symmetry about a vertical line through the centre of the cylinder is not perfect, and the streamlines suggest resistance as well as lift The extent to which air is carried to the back of the cylinder at the higher speeds of rotation is a notable feature shown by the photographs

Measurements of lift showed a maximum lift coefficient of 4 5 (theoretical value 6·28) when the peripheral speed was about four times the forward speed. Instead of the maximum value of 6 28 when the peripheral speed was twice the forward speed, observation gave a value of 2 0. These comparisons show to what extent the neglect of viscosity in the theory has vitiated the conclusions

It will be noticed that high speeds are required at the surface of the cylinder to give the maximum effect

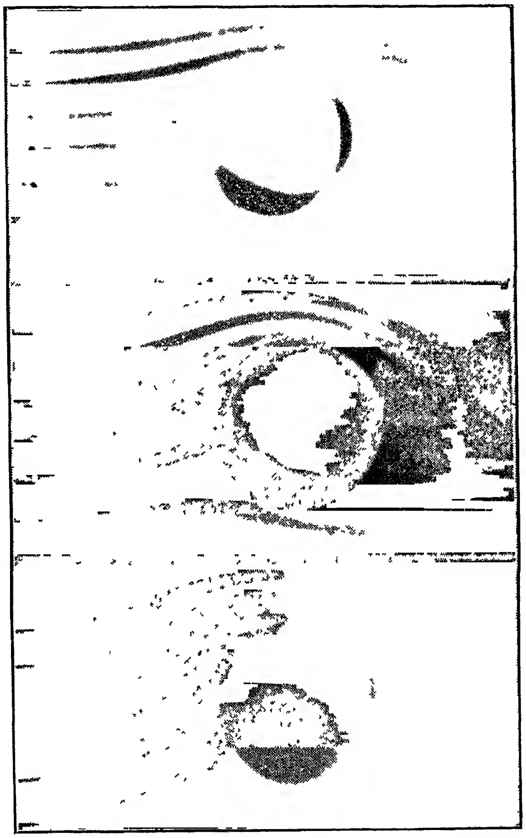

FIG 3—Deflexion of air stream by rotating cylinders top, 600 rev per min, middle, 1200 rev. per min, bottom, 2400 rev per min. Reproduced by courtesy of *Flight*.

Regarded as an aeroplane wing, such high speed would be required at the moment of landing, and if an alighting speed of 30 m p h is aimed at, the surface of the cylinders would need to move at 120 m p h For transport efficiency when once in the air, the factor of greatest importance is the ratio of lift to drag, and on a rotating cylinder this is obtained when the peripheral speed is about two and a half times as great as the forward speed Whilst the Gottingen results give a maximum ratio of 3 5, the American figures give 7·5-8, and the discrepancy is very great. The figures are subject to a deduction for the power required to rotate the cylinders, a deduction of rather uncertain amount but of the order of a quarter to a third of the

values stated. The modern aeroplane has a ratio of lift to drag of 9, and some of the light aeroplanes indicate a figure as high as 12 or 14, so that the best of the results on rotating cylinders compare very unfavourably with the aeroplane for efficiency

Whatever may be the final utility of the rotating cylinder and the commercial fate of the *Buckau*, it may be expected that many attempts will be made to utilise the aspect of fluid motion brought into new prominence by the rotor ship Whilst it is difficult to see immediate uses in aeronautics, there are certain directions in which speculation suggests the possibility of early benefit by a modified application of the principles involved in the propulsion of the rotor ship.

The Mountain Structure and Geographical Relations of South-Eastern Asia.[1]

By Prof. J. W. GREGORY, F.R.S.

THE greatest mountain system in the world is the Alpine-Himalayan, which forms the backbone of Europe and Asia. Its continuity has been proved from western Europe to eastern India. Its further eastward continuation has long been subject of controversy. According to one view it passed north-eastward across central China to Bering Straits, according to another it was bent round against the mass of Chinese Tibet, and passed through western Burma to Sumatra and thence along the southern islands of the Eastern Archipelago. The interpretation of the mountain structure of Chinese Tibet is complicated by being due to movements at two different dates. The later mountains are of the same age as the Alps and Himalaya and are geologically modern. The other group is much older, and its fragments remain as highlands, which are the worn down stumps of the mountain foundations The older system is represented in Europe by the Hercynian Mountains, and in Asia by the Altaids, members of which cross Chinese Tibet on lines approximately north and south, and continue southward as the Indo-Malayan Mountains The Himalayan and Altaid Mountains meet in Chinese Tibet, and the mountain lines due to these two systems have to be carefully distinguished. The Himalayan movements have disturbed the grain due to the older Altaid folding and they admit of simplest proof where the rocks were not in existence when the Altaid Mountains were made For example, the folds and overfolds in the salt-bearing red sandstones of Yunnan must be post-Altaid, as those rocks were not in existence until after the Altaid movements In other places the evidence is more complex. Some of the folds are too shallow to be Altaid, and the arrangement of the outcrop of the older rocks indicates upfolds on lines with the Himalayan trend

The further extension of the Himalayan line eastward of Chinese Tibet is indicated by the claim of the French geologists in Tonkin that at the date of the Himalayan movements a band of country in southern China was pushed southward smashing the country in front of it. The existence of a rich mercury field in south-western China is also in favour of the country having been disturbed by intense mountain movements of the Himalayan period. The continuation of the main Alpine-Himalayan axis therefore appears to pass across southern China, and the Burmese-Malayan Arcs must belong to a loop to the south corresponding to the Atlas-Apennine loop around the western Mediterranean and the Syrian Arc beside the eastern Mediterranean

The traditional cause assigned to such folding as that of the Alps and Himalaya is the contraction of the crust owing to the shrinkage of the earth That theory has been repeatedly criticised in recent years owing to the contraction having been attributed to cooling; but there are more effective and more probable causes of contraction than cooling. That contraction has taken place is proved by the geological evidence. The restriction of the Alpine-Himalayan compression to a long narrow band, varying in latitude from 40° to 48° in Europe, and from 25° to 38° in Asia, is the natural result of that sinking of the northern dome of the world which is shown by the polar flattening. The junction of the northern dome with the tropical belt is naturally one of crumpling and crustal disturbance. This process would produce uplifts in the same zone of the crust around the northern hemisphere, and traces of this continuous upheaval are found. The West Indies and Central America include fragments of mountain chains formed at the same time as the Alps and with a similar trend

The abrupt ending of the mountain grain of the continents on both sides of the Atlantic indicates the former extension of the land into the ocean That the land once crossed the whole width of the Atlantic is supported by the biological evidence. Similar animals are found on opposite sides of the Atlantic in corresponding latitudes, and the resemblances of the South American and African faunas are not likely to be due to passage via Scotland and Greenland if there are no representatives of those groups in Europe or North America The distribution of the ridges and deeps on the North Atlantic floor indicates uplifts in North America and western Europe at the time of the Alpine movements. There is similar evidence of former land extensions across the northern and southern Pacific, such as the occurrence of the alligator in the Yangtze Kiang, the resemblance of the flora of southern China to that of the south-eastern United States, and the occurrence on both sides of the South Pacific of various groups which are unrepresented in the lands on either side of the North Pacific. The biological evidence is supported by the ridges on the Pacific floor and the distribution of the coral islands. The former trans-Atlantic and trans-Pacific connexions must have endured until the time of the Alpine-Himalayan uplifts, for they were broken before the spread of the more specialised mammals and birds, and were available to some living groups of reptiles, amphibians, and specialised invertebrates.

The Indian Ocean was also once occupied by land, the disruption of which has affected the mountain structure of south-eastern Asia. At the end of the

[1] From a discourse delivered at the Royal Institution on Friday, January 30

Altaid uplifts the site of the Indian Ocean was covered by a continent which extended from South America across the Old World to Australia. This continent, Gondwanaland, was broken up by successive subsidences, and the gulfs thus formed were gradually enlarged by further subsidences and so developed into the Atlantic and two basins of the Indian Ocean These movements were accompanied by volcanic eruptions which deluged equatorial Africa and western India under floods of lava, while East Africa was torn asunder by the formation of the Great Rift Valley If these eruptions and fractures were due to the formation of the Indian Ocean, it appeared strange that no corresponding phenomena were known on its eastern side The evidence, however, is now clear that in Burma and western China there were volcanic eruptions which, though on a smaller scale, agree in date with the three main volcanic periods of East Africa, while meridional fractures of the same date as those which made the Great Rift Valley formed the great basins of Yunnan in western China. These fractures in Asia produced features different in some respects from those of East Africa, owing to the difference in structure between the continents East Africa is an ancient solid plateau, whereas Yunnan has an extremely complex foundation due to the intersecting mountain folds The fractures have therefore been less regular and shorter

The date of the later movements in Chinese Tibet is indicated by the river system. The drainage of south-eastern Tibet collects into three rivers which flow for 140 miles on parallel courses through a narrow belt, and instead of joining they then diverge, the Yangtze discharging into the China Sea 2000 miles from the mouth of its neighbour, the Salween. The present river system is the result of a long evolution controlled by the mountain-forming movements The drainage of central and south-eastern Asia in pre-Himalayan times was probably mainly through broad east to west trending valleys due to a gentle buckling of the earth's crust The Himalayan movements confirmed this system, but during the subsequent settling down of the country the eastward outlet of the Tibetan rivers was reduced and Tibet became a land of lakes, to an extent even greater than it is now. Their level rose until they found outlets to the south, through lines of weakness along the Altaid grain The Tibetan rivers through these southern outlets discharged to the South China Sea The upper Brahmaputra or Tsangpo discharged through the Dihang, crossed the site of Assam, and passed through the Hukong Gap to the Irrawadi The Tibetan section of the Yangtze Kiang flowed through Tali Lake to the Red River of Tonkin Further earth movements broke up this system and diverted its western member through the valley of Assam as the Lower Brahmaputra to the Bay of Bengal, and the eastern by a series of deep gorges and striking zigzags across eastern China to the South Pacific.

The geographical relations of the mountains of south-eastern Asia therefore indicate that the Alpine-Himalayan System is a crumpled band of the crust, where the in-sinking northern dome of the world pressed against the tropical belt. The east to west ridges on the floors of the North Atlantic and North Pacific may be attributed to the same forces as produced the Alps and the Himalaya, and the east to west trending mountains, of which remnants are the dominant features in the topography of the West Indies and central America, are also an expression of the buckling of the crust of the Northern Hemisphere where the northern dome of the earth meets its tropical and subtropical belt.

Recent Developments in the Nitrogen-fixation Industry.

WHEN the historian of the future writes concerning the influence of scientific discovery and achievement upon civilisation, we may be sure that he will have much to say about the political and economic effects of the development of the nitrogen-fixation industry Of all the material factors that helped to make the War the greatest and most devastating conflict in human history, the possession by the Germans of adequate plant for making synthetic ammonia, and of adequate personnel for working it, was probably the most important Since that time the processes for fixing atmospheric nitrogen have been further developed, and the present yearly production of fixed nitrogen is approximately 500,000 metric tons, three-quarters of which is made in Germany.

The arc process, the lineal descendant of Cavendish's initial discovery in 1783, now contributes only a relatively small proportion of the total production, namely, about 36,000 m t., its high power-requirement rendering it uneconomical save in countries possessing cheap and abundant water-power The modification of the process involving the use of oxygen-enriched air, which was worked principally in Switzerland and Germany until 1921, had to be abandoned owing to the serious explosions to which it gave rise. The Swiss Nitrum Co., which worked it on a large scale, has recently adopted the Claude process in its stead

Fixation by means of calcium carbide was developed enormously during the War, but the present outlook for this method is not promising calcium cyanamide has not come up to expectations as a nitrogenous fertiliser, and the power-requirement, although only about one-fifth that of the arc process, is 3-4 times greater than that of the direct synthetic-ammonia process. The output of cyanamide has declined to about 140,000 m t per annum, and about one-half of the world's plant capacity is unutilised There are, however, still possibilities, for cyanamide can be used as an intermediate product in the manufacture of urea, of ammonia, and of "Ammo-phos," a fertiliser made on a small scale in the United States.

Urea appears to be the nitrogenous fertiliser of the future. It is the most concentrated of its class; it can be transported and used without difficulty, it leaves neither acid nor alkali behind in the soil; and it has given general satisfaction in experimental work. It will probably be manufactured by combining synthetic ammonia and carbon dioxide at high temperature and pressure Since 1922 a combination of urea and acid phosphate, called "Phosphazote," has been made in Switzerland, and a large works in Norway is to start its production early in the current year.

The Haber process and its modifications, involving the direct union of nitrogen (from liquid air) and

hydrogen in presence of a catalyst, at various temperatures and pressures, now contribute about 65 per cent of the world's supply of fixed nitrogen. In this process the cost of producing and purifying the hydrogen is a dominating factor, in Germany it is prepared from water-gas (Bosch process), in France by fractionating coke-oven gas (Claude process), and in Italy by electrolysing water (Casale and Fausser processes). Electrolytic hydrogen is very pure, but its production is only feasible where water-power is cheap The Casale process is being actively worked in Calabria by a company with a capital of 9 million Swiss francs, and in the United States the Hooker Chemical Co is so satisfied with its success that it has decided to double its plant at Niagara Falls.

Other important factors in the Haber process are the choice of catalysts and the form of marketing the ammonia. In the Fixed-Nitrogen Research Laboratory of the United States Government, improved catalysts have been made which, it is expected, will reduce the cost of ammonia-production by one-half, working on a small scale, at 1500 atmospheres pressure, nearly 80 per cent. of a nitrogen-hydrogen mixture was converted during a single passage through the catalyst Improved catalysts have also been made for the water-gas reaction ($CO + H_2O = H_2 + CO_2$). With these and other improvements it is hoped to reduce the price of ammonia to 5-6 cents per lb

At Billingham-on-Tees, Synthetic Ammonia and Nitrates, Ltd., has started manufacture on a large scale. A modified Haber process is used, and the ammonia is fixed by the calcium-sulphate method, which was developed, and is still used, in Germany. It is probable that synthetic ammonia will be used in conjunction with the Solvay soda process, the ammonia being converted into ammonium chloride, which preliminary trials have shown to be comparable with ammonium sulphate in fertilising value.

The Bucher process of fixing nitrogen as cyanide has not fulfilled expectations, but it appears probable that the du Pont Co. will make it a success. Instead of passing nitrogen (at 15 lb pressure) over soda ash, coke, and a catalyst, this company uses producer-gas and a mixture of carbon black and soda ash (plus catalyst) obtained by evaporating to dryness the "black liquor" which results from boiling wood with caustic soda in the manufacture of wood-pulp, and by heating the residue out of air at 250°-350° C. This mass is very porous, and contains 60-65 per cent. soda ash and 40-35 per cent. carbon, mainly colloidal. The yield of cyanide at this stage is 50-55 per cent, and the period of heating is only 70 per cent of that required in the original process The reaction-product is leached with water, and 96-98 per cent sodium cyanide is obtained by crystallisation The carbon monoxide evolved during heating is mixed with producer-gas and burned under the retorts, which are made of very resistant cast chrome-iron alloy, high in chromium A valuable decolorising carbon is extracted from the residue after leaching. Cyanide, it may be mentioned, can be decomposed by steam to yield ammonia.

The marvellous growth of the nitrogen-fixation industry has naturally excited those interested in the production of Chilean nitrate, the consumption of which has not advanced *pari passu* with that of the artificial products; but the processes used in Chile are known to be wasteful, the Chilean Government could reduce the export tax of 50*s* per ton in case of emergency, and the deposits are likely to last much longer than was originally thought probable. In view, however, of the fact that no other nitrate deposits, in any way comparable with those of Chile, have been discovered, it can only be a question of time—a generation or two—before the synthetic products will hold undisputed sway. It is, of course, possible that means may be found of speeding up nitrification in the soil, but even in that event no nation could afford to be without a nitrogen industry for producing explosives. Furthermore, fixed nitrogen is being increasingly used as ammonia for cold-storage plants, as cyanide for gold extraction, and as nitro-cellulose for making celluloid, artificial leather, and similar products. Great developments of the industry may, therefore, be confidently anticipated.

Obituary.

THE MARQUESS CURZON OF KEDLESTON, K.G., F.R.S

By the death of Lord Curzon, Lord President of the Council, and formerly Viceroy of India and Secretary of State for Foreign Affairs, on March 20, public life in Great Britain has lost one of its most striking personalities. His long and distinguished career in politics had won him high honours in the State; but in a more restricted circle he was held in equal esteem for his scholarship and his efforts to promote those studies with which his interests and pursuits had brought him into touch.

George Nathaniel Curzon, son of Lord Scarsdale, was born on January 11, 1859 After a distinguished career at Eton and Oxford, which included the presidential chair of the union and led to a fellowship of All Souls, Mr. Curzon, as he then was, embarked on a political career, entering Parliament in 1887, first holding office as Under-Secretary of State for India in 1891, by which time he was already recognised as an authority on the East It is unnecessary to enter here into the details of his political career, which are well known. His services to the State were recognised by successive peerages of every grade up to the rank of marquess and the orders of the Garter, the Indian Empire, the Star of India, and the Royal Victorian Order.

Apart from politics, Lord Curzon won distinction as a geographer and student of the peoples of the East Between 1886 and 1894 he visited India four times and twice travelled round the world In 1888 he travelled through Asiatic Russia, recording his observations in his book "Russia in Central Asia." He followed this with a book on Persia and the Persians, a comprehensive account and perhaps his most considerable contribution to geographical literature, which later was to have considerable effect on policy in the Middle East and is still a work of authority This appeared after a journey in Persia as correspondent of the *Times* in 1889, in the course of which he travelled more than 1600 miles on horseback and toured the Persian Gulf. A later book, "Problems of the Far East," dealt with conditions in and the prospects of the countries lying

between India and the Pacific In 1894 he visited the Ameer of Afghanistan—then an undertaking entailing some considerable risk—after tracing the Oxus to its source in the Pamirs Behind his preoccupation with races and people as factors in international politics, Lord Curzon had a fund of sound geographical knowledge, and in fact, as was shown by essays in his often amusing "Stories of Travel," published in 1923, he was a scientific geographer of no small attainment In geography and in the study of peoples, as in his work as an administrator, it was characteristic of him to pursue exhaustive inquiry and to master the available data relating to his subject before arriving at any conclusion on his own observations The result would then be expressed with a lucidity which reflected his clarity of judgment His contributions to geographical science were recognised in 1895 by the award of the Royal Geographical Society's gold medal, an honour which he prized highly

As Viceroy of India Lord Curzon did much to promote science in that country Apart from his lasting reforms in education and his efforts to improve the conditions of agriculture, both being placed under trained officers, he reorganised the archæological service, which had fallen into neglect, reviving the office of Director-General In 1904 he passed a Monuments Act, and he saved from profanation and decay innumerable temples, tombs of kings, mosques, and other buildings throughout India, including the native states. Native arts and industries were fostered, and he created the Imperial Library in the Metcalfe Hall and was responsible for the Victoria Memorial on the Maidan, Calcutta, a gallery of Indian art and history His own researches into the history of his predecessors in the Viceregal office were on the point of publication at the time of his death.

It may be recalled that Lord Curzon and Lord Kitchener were the principal guests of the Royal Society at its anniversary dinner in 1898. Within a few days both were due to leave England to take up their new Indian appointments. In a letter to Lord Lister, the president, a few days prior to the banquet, Lord Curzon wrote: "It is the instinct of the hunted animal to fly, but your invitation to me has been expressed so gracefully that I cannot but accept." Lord Curzon made an interesting speech at the dinner, referring, among other matters, to a Viceroy's horoscope An outgoing Viceroy, he said, is fêted and dined and toasted before he has gone out to his work, and, indeed, before he has done anything at all Five years later, upon his return, he slips back into Great Britain almost unperceived, and retires, very likely, into an obscurity which may or may not be merited, but is, at any rate, in striking contrast to the plaudits which attended his departure Happily, in Lord Curzon's case, such prophecy was unfulfilled

Lord Curzon's interest in the relics of antiquity were not confined to India. It was through his efforts that Tattershall Castle, Lincolnshire, was saved for the nation when about to be demolished, and through him the castles at Bodiam in Sussex, and Montacute in Somerset, were also preserved

Lord Curzon was the recipient of many honours bestowed by the learned and scientific world He was president of the Royal Geographical Society from 1911 until 1914 He was elected Chancellor of the University of Oxford in 1907, when he took a prominent part in the movement for "reform from within" He was Lord Rector of the University of Glasgow in 1908, Romanes Lecturer at Oxford in 1907, and Reed Lecturer at Cambridge in 1913 He was an honorary fellow of Balliol, and held honorary degrees from the Universities of Oxford, Cambridge, Glasgow, and Manchester. He was a fellow of the Royal Society and British Academy, and had accepted the presidency of the English Association not very long before his death.

LORD CURZON IN INDIA

EXCEPT in so far as it had a direct influence on economic development or on humanitarian problems, Lord Curzon, during his Indian Viceroyalty, showed no marked interest in scientific research. Science did not appeal to him as a branch of culture comparable to history and literature It is true that, four years before he was appointed Viceroy, he had made a distinct mark as an explorer in the Pamirs, when he solved the problem of the source of the Oxus; but this diversion to physical geography was rather an accidental by-product in a journey mainly devoted to the political aspects of geography and sport. Still, the recognition of this work by the Royal Geographical Society left him with the impression that geography at any rate was a science, and, so far as one could guess from his official and personal activities in India, it gave him the impression also that science was geography. Workers in other branches he seemed to regard as having a limited usefulness in solving political and economic problems, and sometimes in assisting his remarkable work in restoring respect for India's unappreciated relics of archæological and historical value His action in dispersing the fine collection of fishes (which had been prepared by Col. Alcock in the Calcutta Museum), to provide an opportunity for a preliminary display of the historical collections designed for the Victoria Memorial, revealed his want of appreciation of the claims of those forms of culture that had had no part in his earlier education. Fortunately, no other science workers offered obstacles to his activities, and so they could not share to the full the resentment displayed by the zoologists.

Nevertheless, when Lord Curzon realised that science was necessary for economic progress, he recognised the value of laying sound foundations in research which could offer no prospect of definite results in his own time. In this matter he was fortunate in having as members of his Government two Ministers—Sir Denzil Ibbetson and Sir John Hewett—who realised that the development of pure science was essential to solid advancement in its application Lord Curzon's institution of the Imperial Agricultural Department, by recruiting into one service a strong staff of chemists, botanists, plant pathologists, entomologists, and other specialists devoted to agricultural problems, has already brought to the Indian cultivator direct returns in increased output annually, many times more than the total cost of the new service from its start

Although most science workers in India during the years 1898 to 1905 remained outside the Viceroy's wide range of active interests, the wiser among them realised that their position was not without some advantages, his zeal for reform was dominated always by a desire for centralised control and symmetry in system of administration—conditions which may have conduced

to increased efficiency, but were never accomplished without trespass on local sentiment or without interference with individual liberty in research work Fortunately, he found urgent problems in other fields, even more than enough for his apparently unlimited energy and never-failing sense of duty

In the *Sunday Times* of March 22, Mr. Newman Flower mentions the fact that the night before his operation, which he knew might be fatal, Lord Curzon wrote minute instructions about his forthcoming book on "British Government in India," and this incident reminded me of a somewhat similar illustration of his remarkable regard for small things in spite of greater distractions In 1905, when the controversy with Lord Kitchener, which led to his resignation, was at its height, Lord Curzon sent me long notes from Simla about certain marble pedestals in Government House which he had asked me, during the previous Calcutta session, to take a personal interest in and to have erected before the arrival of the Prince of Wales

It was not until after 1916, when war conditions forced upon one many duties of an unfamiliar nature, that one saw further direct evidence to show the great depth as well as width of Lord Curzon's marvellous activities in railway extension, in university education, in public health, in town-planning, in industrial developments, in army administration, and, most remarkable of all, in the complex problems of land revenue which not even an experienced member of the Civil Service professed to understand for any but his own province His views were expressed in reasoned notes that left one with the impression that each file in turn covered the one subject in which he had specialised. Five years' experience with the Government of India, where the records of his previous work are filed, left me with two outstanding impressions—first, an inexpressible admiration for his energy, thoroughness, and conscientious devotion to India; and secondly, an equally strong feeling of thankfulness that geology was not one of the subjects in which he had occasion to specialise between 1898 and 1905 T H HOLLAND.

PROF A. VON WASSERMANN

WE regret to record the death on March 16, at sixty years of age, of August von Wassermann in Berlin. He was born in Bamberg, and having studied in Strasbourg, Vienna, and Berlin, early became associated with the Institute for Infectious Diseases under Koch, and it was here that most of his work was done. He ultimately became Director of the Serum department of Koch's Institute, and in 1913 Director of the large Institute of Experimental Therapy of the vast Kaiser-Wilhelm Gesellschaft zur Forderung der Wissenschaft in Dahlem, Berlin He was also honorary professor in the University of Berlin and was ennobled in 1910.

Von Wassermann's scientific life-work was done in the domain of immunity; he saw its rise and zenith and contributed in no small degree to its development. He was an exceedingly clever man, untiring in his diligence, and in the highest degree efficient if lacking in imagination when compared with the greatest workers in his science Throughout the development of immunity problems he was constantly on the alert, and felt almost every pulsation of advancement of knowledge with extraordinary acumen Although rarely the first on the field, he was almost invariably among the first to take full advantage of anything new, and he always added something fresh and clever to work already done He was a typical "Prussian," somewhat arrogant to his inferiors, but withal a man that was liked. He was a brilliant speaker, and a great star at medical gatherings and congresses, where he was always listened to with attention. As an example of his diligence we may cite the "Handbuch der pathogenen Mikroorganismen" which he edited with W Kolle This monumental if somewhat uncritical work appeared in two editions, the first in six volumes between 1903 and 1909, the second in eight volumes with nearly nine thousand pages, all of which was published within two years (1912–1913)

From 1906 Wassermann attained world-wide fame, and his name became almost a household word through his discovery of the so-called Wassermann reaction in the diagnosis of syphilis In its altered form, this test is practised in every pathological laboratory the world over, and is perhaps the most accurate laboratory test applied to the clinical diagnosis of disease Wassermann's test was the practical application of a fundamental principle discovered by Bordet and Gengou (1901) of Brussels, and it was characteristic of him that he saw almost immediately how Bordet's work could be utilised for human medicine Wassermann's name will live long in the annals of bacteriology and immunology. W B.

DR WILLIAM F HILLEBRAND, chief chemist of the United States Bureau of Standards, died on February 7 at the age of seventy-one years, and an appreciative account of his life and work by a colleague at the Bureau of Standards has been published in a recent issue of *Science*. William Francis Hillebrand spent two years at Cornell University before taking up chemistry, most of his training in which was received in Europe In 1872 he went to Heidelberg to study under Bunsen and Kirchhoff, and from there, he and T H Norton published in 1875 their paper on the preparation of metallic cerium, lanthanum, and the mixture then called didymium Hillebrand's later work showed these metals were trivalent and belonged to the rare earth group He also discovered the pyrophoric properties of cerium filings From Heidelberg Dr Hillebrand went to Strassburg under Fittig, and from there to the Mining Academy at Freiburg Returning to the United States, he was appointed to the staff of the Geological Survey in 1880, and until 1885 was stationed at Denver. Here was plenty of mineral material to exercise his growing skill as an analyst, and the work was continued after his transfer to Washington In 1908 he became second chief of the Bureau of Standards Dr Hillebrand devised general analytical procedures suitable for different types of mineral and rock, and also special methods for the determination of individual elements, which were placed on record in various issues of the Bulletin of the Geological Survey, silicate rocks were dealt with in 1897, carbonate rocks in 1907, both of which were quickly translated into German Dr. Hillebrand was a member of the National Academy of Sciences, and in 1906 was president of the American Chemical Society, for many years he served as an associate-editor of this Society's Journal and also of the *Journal of Industrial and Engineering Chemistry*.

Current Topics and Events.

OUR readers will no doubt be interested in the photograph we publish showing Prof Raymond Dart, of the Witwatersrand University, Johannesburg, with the Taungs skull Prof Dart, who is well known to anatomists in Great Britain, was trained under Prof J T Wilson, now professor of anatomy at the University of Cambridge, and worked in London at the Royal College of Surgeons, and under Prof Elliot Smith at University College in 1919, where he paid special attention to problems of the brain and to the skull of fossil man Before taking up his appointment in South Africa he was one of three selected by Prof. Elliot Smith from his staff, at the request of the Trustees of the Rockefeller Foundation, to visit the medical schools of the United States. A certain amount of criticism has been levelled at Prof Dart's nomenclature of the Taungs skull It is generally felt that the name Australopithecus is an unpleasing hybrid as well as etymologically incorrect Dr J G de Barros e Cunha, of the Institute of Anthropology, Coimbra, who is among those who take exception to the title on these grounds, also writes to point out that if a new family of *homo-simudæ* is constituted, the generic name should be Homosimis, whereas the generic name, Australopithecus, would require the family name Australopithecidæ Although it may be a little premature to decide, present information does not force either alternative upon us, as there does not seem to be adequate ground for the creation of a new family Meanwhile the criticism continues, and in a cable which appeared in the *Times* of March 11, Prof Dart defends himself with some humour but in a manner which suggests that the niceties of etymology do not greatly appeal to him

Prof Raymond Dart with the Taungs skull

PROF L VEGARD sends us the following cable message from Oslo, dated March 20: "Shown by experiments in mixtures of nitrogen and neon at the Leyden Laboratory that auroral line is the limit to which the band N_1 approaches by diminishing size of nitrogen particles" Prof Vegard described his observations of the luminescence of solid nitrogen, and the structure of the two bands in the green part of the spectrum, called by him N_1 and N_2, in communications to NATURE of September 6 and November 15, 1924

ALTHOUGH the Coal Conservation Report was issued in 1918, there is still considerable difference of opinion amongst electrical engineers as to the advisability of mapping Britain out into power zones each served by super power stations of high thermal efficiency It is admitted that there are many small stations which burn fuel extravagantly, but in some of our larger stations the thermal efficiency is about 20 per cent and is still increasing This compares favourably with anything that has been done by the super power stations in the United States, where the power zone system is adopted There is one aspect of the problem, however, to which more attention should be directed, namely, the possibilities of interlinking various supply systems by reversible motor-generators so that one company can help the other during times of heavy load Even if the systems of supply be alternating current of different frequency, suitable electrical devices called frequency transformers can be used for this purpose When this is done, in nearly every case the ratio of the average demand on a station to the maximum possible demand is largely increased The overhead charges are thus considerably reduced and will justify a reduction of price to the consumer The linking together recently of three power stations in Berlin has had the effect of raising this ratio—the so-called "load factor"—to 57 per cent, and made possible considerable economies. The tables published by the Electricity Commissioners prove conclusively that the larger the power station the higher the thermal efficiency The main difficulties in the way of getting a cheaper supply of electricity, and a more efficient one from the point of view of fuel consumption, are in connexion with raising the capital required for providing the necessary distribution mains Various schemes have been suggested for overcoming these difficulties, but no general agreement has yet been attained

THE pages of American scientific and technical periodicals have for some time provided evidence of considerable activity in the field of colloid chemistry This is not confined to individual work, but there has been a good deal of concerted action directed towards promoting and facilitating the study of the discipline The Colloids Committee of the National Research Council some time ago issued a fairly complete bibliography of the subject, and has now put forward a definite scheme for the establishment of a National

Institute for Research in Colloid Chemistry The scheme itself, some of the general claims of colloid chemistry, and a number of successful applications to technical problems are described in a beautifully printed and illustrated booklet published by the University of Wisconsin. This institution puts forward a number of reasons why the proposed Research Institute should be located in its grounds, one of the reasons being the enthusiastic support given to the lectures and research classes held by Prof The Svedberg of Upsala during part of the year 1923 and the subsequent "symposium" on the subject. The scheme suggests the raising of a sum of one million dollars, a quarter of which is to be devoted to buildings and equipment and the remaining three-quarters to endowment A director of research, for whose specified qualifications a salary of 8000 dollars does not seem excessive, a director of the laboratory and two research fellows with salaries of 6000 dollars each, are contemplated There is very little doubt that the money will be easily obtained, and, whatever view one may take of the possibilities of gregarious research, it is impossible to avoid slightly envious comparisons between the colloids "boom" in the United States and the very inadequate provision for teaching and research on the subject in Great Britain.

THOSE responsible for airship development in the United States and in Great Britain have drawn many comparisons with the development of marine transport. To balance their natural optimism a note of caution may be sounded The new airships are to displace 140,000 cub m volume and 150 tonnes mass of air A ship of the same volume displacement of water would have a mass displacement of 110,000 tonnes The air leviathans are, of necessity, bubbles lighter than air Most marine harbours have protected approaches so that in stormy weather ships pass by degrees from the waves of the open sea to completely protected waters before making actual contact with dock or quay. Where the approaches are bad in certain winds, arriving vessels may have to turn back, an experience not unknown to channel passengers. Unfortunately, all airship harbours are bad in all high winds, and if in spite of weather forecasting an airship is caught outside its shed, it must ride out the storm under power or at the mooring mast With ships, the maximum hogging and sagging stresses increase until the length of the ship exceeds the maximum wave-length, as is the case with Atlantic liners There is no authoritative information as to the analogous air stresses, but American experience with the *Shenandoah* is held to confirm the belief that these are much greater than the stresses produced by manœuvring in still air. This, then, seems to be the ultimate standard by which the airship will be tested unless it is to remain in its shed until fair weather is predictable with certainty

THE first manufacture of fused silica ware was a British achievement, and it is satisfactory to learn that the industry which grew from small beginnings at Wallsend-on-Tyne in the early years of this century is still flourishing and well maintaining its pre-eminent position both at home and abroad Like many other useful inventions, the applications of fused sand and quartz to the construction of laboratory apparatus and to parts of large-scale plant developed at first with extreme slowness, but circumstances arising from the War provided the necessary impetus for their extension. the cutting off of supplies of German porcelain and the recognition of the value of silica condensing-systems for nitric-acid vapour and of silica basins for concentrating sulphuric acid were mainly responsible for the change Since the end of the War a demand has arisen for silica cooling and absorption plant in the manufacture of hydrochloric acid, both by the old process and by burning hydrogen in an atmosphere of chlorine Silica stills for the concentration of pure sulphuric acid have also been in request, as silica is the only material that can satisfactorily replace platinum for this purpose By far the most important new application is the manufacture of gas globes and of bowls for indirect lighting, more fused silica being used for this than for any other purpose. In the immediate future a considerable demand for it is anticipated for making the envelopes of large thermionic valves and the condensers of "radio" sets.

THE number and variety of laboratory appliances made of fused silica are also increasing, and among the latest of these is a mercury condensation pump, which is fully described in the most recent catalogue issued by the Thermal Syndicate, Ltd, of Wallsend-on-Tyne This pump, measuring 25 cm in length, is made entirely of fused quartz, and worked in conjunction with a backing pump giving a vacuum of 0·2 mm of mercury, it provides a vacuum of 0·000002 mm, it is operated with only 5 c c of mercury, can be heated either by gas or electricity, and is water-cooled The increased use of fused silica ware for scientific and technical purposes would appear to depend mainly upon its price It is not easy to manufacture, skilled labour is essential, the necessary electrical equipment is costly, and only very pure raw materials, such as sand from Fontainebleau and quartz crystals from Madagascar, can be used In spite of these circumstances, considerable progress has been made in reducing production costs, and only a big demand is needed to permit of an appreciable reduction in selling price, and to enable silica ware to compete in price with materials which have hitherto been thought to be much easier to produce The opacity or translucency of articles made from sand is known to be due to the presence of small air-bubbles and not to impurities in the raw materials These air-bubbles cannot be expelled because the fused sand is very viscous, melted quartz-crystal, on the other hand, is quite mobile The translucent material is, however, quite suitable for most objects, especially when these are glazed, and for some purposes, for example, the manufacture of gas globes, it is to be preferred.

THE British Non-ferrous Metals Research Association has just issued a report on the research work in

progress or completed under the auspices of the Association The record is a striking one A graph which is attached to the pamphlet shows that the expenditure on experimental research, which in 1921, the second year of the existence of the Association, was only 1500*l*, will amount during the present year to close on 16,000*l* The most interesting feature of the report is the attention given to the scientific study of alloys The Council of the Association has taken a very broad view, and most of the work is devoted to fundamental problems rather than to the solution of immediate workshop difficulties It has been decided to establish a small central laboratory, attached to the University of Birmingham, for the use of the Superintendent of Research and also for carrying out preliminary investigations, but the policy of the Association is to have its researches conducted mainly in the universities and other specially equipped laboratories of the country A glance through the pamphlet shows that at least thirty separate research workers are engaged in various laboratories under the supervision of their respective professors or directors The non-ferrous metal industry is an extensive one, and there are still branches of it which are not represented in the Association; firms which have not yet seen the benefit of co-operative research of this kind cannot do better than study the present pamphlet One consequence of the present programme, of interest to physicists as well as to metallurgists, will be the exact determination of the physical properties of many non-ferrous metals and alloys, a subject on which information at present is singularly imperfect, as will be realised by any one who consults the standard volumes of tables of physical constants

"WINDOLITE" is the name given to an aceto-cellulose wire-net reinforced substitute for glass It offers a very thin film in the meshes of the wire net, and transmits the ultra-violet rays One sample tested transmitted light right down to 232 $\mu\mu$, while ordinary window glass cuts off rays shorter than about 330 $\mu\mu$ The most active biological rays, so far as the skin is concerned, are about 300-290 $\mu\mu$, and these are the rays which come through with the high sun on clear days Windolite should be useful for open-air shelters, verandahs, etc. The makers inform us that gardeners find it draws plants less than glass, and that this is not due to great coolness of the garden frame or house It should be interesting to see how well plants grow under it, and whether the anti-rachitic substance and the growth vitamin A are present more in plants grown with ultra-violet rays than without The present writer has tried cress, and so far has found no difference on young rats in the growth-promoting power, but that may be due to vitamin A derived from the seeds Hess in the United States states that market salad has not got anti-rachitic power, but can be given this by radiation. A new glass has also been submitted to us—Lamplough's Vitaglass, this as rolled is a "cathedral glass," but it can be blown clear It lets ultra-violet rays through down to 275 $\mu\mu$, costs about 3*s* a square foot, and should be useful for skylights, verandahs, upper parts of windows of hospitals, sanatoria, schools, nurseries, and possibly for green-houses if fruit and salads are found to be improved in quality by ultra-violet rays Blown clear it will be useful for bulbs of tungsten filament quartz lamps, allowing us to get some gentle ultra-violet rays from these

A DESTRUCTIVE tornado struck Annapolis, Missouri, shortly after 1 o'clock in the afternoon of March 18, swept north-eastward across the Mississippi River, traversing Southern Illinois, and at Elizabeth, Indiana, broke into two lesser storms, which tore pathways through Tennessee and Central Kentucky. The *Times* reports that many towns were completely cut off from communication with the outside world, and others were threatened with destruction by fires which broke out among the ruins Murphysboro, De Soto and West Frankfort in Illinois, Griffin, Owensville and Princeton in Indiana, and Witham in Tennessee are said to have borne the full force of the storm At South Greenfield, Illinois, a passenger train was overturned by the wind and several persons were killed In one place about 50 motor-cars were piled in a tangled ruin Illinois seems to have been the heaviest sufferer, with 645 known dead and 1945 injured The latest ascertained figure, to March 20, for all five States is 823 dead and 2990 injured, but many bodies are still buried in the wreckage The storm tore its way over a length of 150 miles Often its path was only 300 ft. wide There are places where it uprooted oak trees a foot thick and split apart heavy stone buildings, but left unscathed flimsy cottages and mere shacks

THE annual report of the Meteorological Office, Air Ministry, for the year ended March 31, 1924, has recently been published. It is the sixty-ninth year of the Office and the fourth year that the cost of the Office has been borne by the Air Ministry. The report shows a large increase in the staff in comparison with a few years ago, as well as an immense increase in the work undertaken A good deal of reorganisation has been taken in hand The Office has apparently attained its normal condition and little further development is expected for some years Details are given of international work, especially in relation to a common system of reports required for purposes of aviation. The Marine Division has achieved fresh work, including the establishment of the *Marine Observer* and the *Weather Shipping* wireless bulletin Much weather information is gathered for all oceans from voluntary observers The Forecast Division has made some progress, 84 per cent of the gale warnings for the whole of Great Britain were followed by gales or strong winds The ordinary daily forecasts can be obtained, free of charge, by telephone or from broadcasting stations The Climatological Division deals primarily with the weather of the British Islands, and numerous observations are gathered from all parts of the globe The Office is interwoven with the Navy, the Army, and the Air Force Much research is made with regard to the upper air, 8360 single-theodolite pilot-balloon ascents were made during the year, and 236 aeroplane ascents were made by pilots of the

Royal Air Force to determine upper-air temperatures and humidities The British Rainfall Organisation and observations in connexion with atmospheric pollution afford much valuable material of general utility

DURING the course of the Pasteur centenary celebrations, held in May 1923, a Pasteur "day" was held throughout France, when badges were sold in aid of the scientific laboratories of the country Some nine million francs were collected in this way, while the *Matin* raised a further three million francs by subscription A committee under the chairmanship of M. Émile Picard, permanent secretary of the Paris Academy of Science, was appointed to distribute the fund, and a list of the allocations has recently been issued Grouping the awards according to subject, they are as follows: 2,143,000 francs to physics, of which 1,000,000 francs is reserved for the construction of a powerful electromagnet for the Paris Academy of Sciences, 1,340,000 francs to chemistry; 1,150,000 francs for astronomy, of which 650,000 francs will be for a photographic instrument and for a reflector of 1·20 m. aperture, 160,000 francs to mathematics, 120,000 francs of which is for the publication of the works of Henri Poincaré, 190,000 francs to meteorology; 245,000 francs to geography and navigation, 333,000 francs to geology and mineralogy, 630,000 francs to zoology, 640,000 francs to botany, 576,000 to physiology and medicine, 105,000 francs to microbiology, 75,000 francs to agriculture, 600,000 francs for the general biology of the Colonies, 510,000 francs for industrial research and institutions. The three million francs collected by the *Matin* is to be invested and the interest used for prizes and grants. The complete list of the grants appears in the *Revue scientifique* for February 28

THE fourth annual report, just presented, of the National Institute of Industrial Psychology shows a most interesting development of the work in many directions The application of scientific knowledge and methods to industrial problems cannot fail to have far-reaching results not only for the firm or industry studied, but also for the sciences applied for the elucidation of its problems, in the course of the application of the scientific principles new data will be available whereby knowledge will be extended The investigations for the year cover a very wide field—coal-mining and chocolate-making, dressmaking and restaurant breakages, to mention but a few The problems studied have involved—protection from extreme heat, effects of long standing, the mental irritation and worry in connexion with breakages, ventilation and atmospheric pollution Not the least important part of the Institute's work is concerned with the guidance of children just leaving school, this aspect has been considerably enlarged during the year, owing to a generous grant from the Carnegie United Kingdom Trust, and research work is in progress The Institute is also conducting an educational campaign by means of lectures and meetings for both scientific and industrial audiences

THE Textile Institute, the headquarters of which are at St Mary's Parsonage, Manchester, with London branch office at 38 Bloomsbury Square, has now received a Royal Charter of Incorporation granted by His Majesty's Privy Council by Letters Patent under the date of March 11 The Charter will enable the Institute, in addition to its other powers, to hold examinations and to grant certificates of competency to practise, teach, or profess textile technology The Institute was formed in 1910 and registered under the Companies (Consolidation) Act, 1908, as a company limited by guarantee For several years past the question of qualifications in connexion with membership has been under consideration, but it was not until the existing president, Mr John Emsley, of Bradford, came forward with a definite proposal, accompanied by a generous offer, that it was decided to petition for a Royal Charter of Incorporation. The object of the Institute in adopting this course was to secure not only a higher general status for the organisation, but also that fellowships or associateships which may be granted shall be issued under satisfactory conditions of authorisation The annual general meeting and spring conference is to take place at Manchester on April 29, whilst the annual conference will be at Edinburgh during Whit-week next At Edinburgh, the Mather Lecture of the Institute will be given by Prof A J Sargent, of the London School of Economics, whose subject will be "The World Problems of Wool and Cotton"

AT the annual general meeting of the Geological Society of London, held on February 20, the following officers were elected *President*, Dr J W Evans; *Vice-Presidents*, Dr J S Flett, Sir Thomas Holland, Prof A C Seward, and Sir Arthur Smith Woodward; *Secretaries*, Mr W Campbell Smith and Dr J A. Douglas, *Foreign Secretary*, Prof J E Marr; and *Treasurer*, Mr R S Herries

THE Ordnance Survey has published Sheet 44, Mull, of the coloured printed one-inch geological survey of Scotland. The sheet covers an area of involved geological detail and is a beautiful example of fine colour printing. The number of colours used is considerable, and some of them appear in very small area, but the register and general cartographical technique show no flaw throughout the sheet

WE have received from M. Jacques Boyer, 5 bis, rue Saint-Paul, Paris, a copy of the fourth edition of his "Catalogue de photographies documentaires." It gives a list of the photographic illustrations that he can supply relating to scientific, industrial, and military matters, agriculture, horticulture, geography, aeronautics, automobilism, and portraits of savants and technologists This last section alone consists of about five thousand portraits, historical characters being taken from the most authentic records The list of this section is not given The few sample reproductions included are of excellent quality.

A NEW edition, No 924, of a catalogue of petrological microscopes issued by Messrs James Swift and Son, Ltd, 81 Tottenham Court Road, London,

W 1, contains a large and comprehensive collection of microscope outfits for use in petrology, mineralogy, and crystallography The list includes instruments suitable for elementary students, as well as more elaborate types adapted for the most exacting investigations A petrological microscope, being an instrument for observing and measuring the optical properties of rocks, minerals and crystals, requires many special fittings and adjustments which are not necessary in a microscope for use in the biological sciences The models described in the catalogue have been designed primarily for petrological work, and incorporate many of the latest devices for simplifying adjustments and for securing rigidity and accuracy

MESSRS Bernard Quaritch, Ltd , 11 Grafton Street, W 1, have recently circulated Catalogue No 390 dealing with nearly 1900 second-hand works on zoology, botany (including agriculture, forestry, fruit-culture and gardening), and geology As is usual with the catalogues of this bookseller, many choice and rare publications are listed

MESSRS W Heffer and Sons, Ltd , 4 Petty Cury, Cambridge, have just published a lengthy and well-arranged catalogue (No 248) of second-hand works in the following branches of science :—Mathematics and physics, astronomy and meteorology, engineering, wireless telegraphy, agriculture, husbandry, and farriery, anthropology and ethnology, botany, chemistry, chemical technology and metallurgy, geology, mineralogy and palæontology, zoology and biology, physiology, anatomy and medicine Upwards of 3500 books are named, and in addition there is a long list of complete sets of scientific serials which Messrs. Heffer have for disposal The list is to be had upon application

Our Astronomical Column.

THE BEGINNING OF THE JULIAN DAY —There is a lamentable state of confusion in the astronomical world as to whether the Julian Day should begin at noon or midnight Some countries, following the lead of the United States, have decided on beginning at midnight But the Astronomical Society of the Netherlands continues the noon reckoning, and many people in the British Isles propose to do the same, some of these quote the fact that no change has been made in the Julian Day table of the Nautical Almanac as registering an official decision in this sense The fact is, however, that no such decision has been reached, and in its absence the wording of the Nautical Almanac remains as before

While it is possible to make a good case for either noon or midnight, the use of different systems in different countries cannot fail to be a source of great confusion, and it is earnestly to be hoped that an official decision will be registered by the Astronomical Union at its meeting in July The present year must in any case be one of confusion, but the sooner that state is ended the better

THE TOTAL SOLAR ECLIPSE OF JANUARY 24 —The *Scientific American* for March describes this as "the best observed eclipse in history" It was certainly the most populous region that the moon's shadow has traversed since modern methods have been introduced, and the article states that thousands of volunteer observers were engaged in observing the exact limits of the zone of totality and similar researches Five successful colour photographs of the corona were obtained, and the reproduction of one of them is promised in the next issue "The great spectacle was not marred by so much as a single wisp of cloud"

The times of the beginning and end of totality were telegraphically recorded on two chronographs, one at New Haven, the other in New York, this facilitated the rapid comparison of results, which were thus available in the cable message despatched to Europe the same day The main feature of the eclipse as a whole was the eager co-operation of thousands of people in a great many directions, including the effect of the shadow on wireless transmission There is little doubt that the full report will add to our knowledge very considerably

The errors in the calculated times of beginning of totality, given in NATURE for January 31, were taken from the cabled reports in the *Observer* for January 25 They were very nearly correct, but need a little revision, which can now be made, thanks to a courteous communication from the editor of the *Scientific American* The observed times were late on the predicted ones as follows, Ithaca, 5 sec, Poughkeepsie, 2 7 sec, New Haven, 4 7 sec, Easthampton, 5 5 sec, mean, 4 5 sec, practically identical with that given before The time at Buffalo was noted as 0 3 sec early, but uncertain owing to cloud

Easthampton, on Long Island, was occupied by a party despatched by the *Scientific American* It was at this station that five successful colour photographs of the corona were obtained by Mr Edward R Hewitt, who has devised a very rapid process for such photographs

MOVING ABSORBING VAPOURS AT GREAT HEIGHTS ABOVE THE PHOTOSPHERE —Observations with the photographic recording spectrometer as employed by Deslandres in 1910 give the changes in appearance of a line emitted or absorbed by a chromospheric vapour and also its radial velocity Certain filaments are found to develop violent movements, after which they generally disappear or are much weakened. These phenomena are not observed with the spectroheliograph since its narrow second slit is adjusted for a line of the stationary vapour, and when this line is affected by the Doppler effect, it does not pass through it at all M L d'Azambuja, in the *C R Acad Sci Paris*, January 5, describes six cases which he has observed in the Meudon Observatory from April 1919 to January 1921, using the calcium K_3 line, four of which are similar to that described by Deslandres, and show radial, but no horizontal, movement The two others, however, show rapid and extensive horizontal movements, and in addition important radial ones Maps are given showing the forms and positions of these filaments at different times, together with the positions on the solar disc which they would have occupied had there been no horizontal movement The filaments were seen at first on the spectroheliograms, but not when the radial velocity became large The maximum velocity towards the observer of one of the filaments was about 25 km /sec, and it was estimated that it must have reached a height of 225,000 km, or about one-sixth of the solar diameter No trace of it was left about an hour after it was last seen It is probable that the same phenomena are involved as in the formation of a temporary protuberance at the edge of the solar disc

Research Items.

INDIAN ARCHÆOLOGY.—A "Note on Prehistoric Antiquities including Antiquities from Mohen-jo-daro" by Mr. Ramaprasad Chanda, Superintendent of the Archæological Section of the Indian Museum, Calcutta, which was written for a visit to the Museum made by the Viceroy in December last, gives a valuable bird's-eye view of the archæology of India as illustrated by exhibits in the Museum. The specimens include palæoliths from the Deccan, the Central Indian Plateau, Rajputana, and Eastern India. These approach most nearly to the Chellean and Acheulean types. Typical neoliths have been collected from nearly all the provinces of India. Of the remains of the Copper Age, which followed the Neolithic in Northern and Central India, the most remarkable are the hoard from Gungeria, Central Provinces, consisting of 424 hammered copper implements and 102 thin silver plates, and a find of nine double axes from the Gulpha River in the Mayurbhanj State. Antiquities found at Mohen-jo-daro and Harappa are now on loan in the Museum, among them being the seals with the unknown pictographic script, the pottery, and other objects which, it is suggested, show Sumerian affinities. It is not generally known that three seals showing this pictographic script were discovered at Harappa in 1872 and in the 'eighties of the last century and were presented to the British Museum, where they are now exhibited.

RACIAL CHARACTER.—An interesting question is raised in two papers published in the Proceedings of the American Philosophical Society, vol. 63, No. 2, which discuss the question of potential equality in the various races of man. In the first, Dr. H. N. Hall maintains that if the test of history be applied to the negro race, and its past examined with the view of predicting its future, it appears that its mental disposition remains unchanged and seems unchangeable. The argument is based upon a study of the culture of the negro and, in this instance, the divine or magical character of the kingship which in Africa, owing to the absence of social or political checks which elsewhere served as a counterbalance to the royal divinity, was incapable of useful development. This was the result of a weakness of will in the negro mind which necessitated the support of a superior. Dr. Goldenweiser, on the other hand, argues that neither physically nor biologically are there any differences in the races of man which permit a grading into a progressive series from the animal upward, as, *e.g.*, in the case of hairiness, which is extreme in the Australian and European, but slight only in the Negro, Mongol, and American Indian; nor has psychology yet furnished any evidence to assist in grading, while the tests of culture, religion, and morality depend upon a bias determined by our own point of view.

POLLINATION AND COMMERCIAL FRUIT GROWING.—Among the many factors that affect the good or bad cropping of fruit orchards, it has become recognised that self-sterility or self-fruitfulness plays a very considerable part. Numerous experiments have shown that comparatively few varieties of the more important fruits are able to produce good crops unless they are cross-pollinated from another variety growing near by, and to this fact the poor cropping power of certain orchards is largely to be attributed. C. H. Hooper, in "Fruit Pollination in Relation to Commercial Fruit Growing" (Fruit Bull. 10, S.E. Agric. Coll., Wye), sets out the analysed results of his own and many other records, the compiled lists affording definite guidance to fruit planters. The smaller soft fruits all appear to be perfectly self-fruitful, but most need the agency of insects to effect cross-pollination from other plants of the same variety, strawberries being almost the only crop which is chiefly fertilised by wind. In the case of apple, pear, plum, and cherry, however, many varieties are unable to mature fruit with their own pollen; every orchard should thus contain at least two varieties flowering at approximately the same time and capable of cross-fertilisation. The difference between the earliest dates of flowering of varieties of the same fruit is considerable, averaging about twenty days for apples, twelve for pears, nineteen for plums, and three weeks or more for cherries. The chief varieties are listed according to whether they are earliest, early, mid-season or late, and an indication is given of the degree to which each is self-sterile or self-fruitful. In addition, examples are given of varieties that have been proved by experiment to fruit well together, and the recommendation is made that if trees of one variety only have been planted, about one tree in eight should be regrafted or replaced by another variety flowering about the same time. For apples, Bramley's seedling is suggested as a specially good variety with which to regraft. The importance of insects in fruit pollination is emphasised, and bee-keeping is recommended for growers with large areas of a certain fruit. Many other factors are recognised as influencing fruitfulness, but the question of imperfect fertilisation of the flower is less usually recognised, and is of sufficient importance to justify special attention being directed to its possible occurrence in cases of persistent poor cropping.

THE PRACTICE OF ENSILAGE.—Silage has now become of considerable importance as a stock food, after a somewhat chequered history, and Amos (Journ. Min. Agric. 31, Nos. 8, 9, 11) outlines the present-day knowledge of the process of ensilage and the methods practised in Great Britain. The quality of silage varies much with the conditions of manufacture, sweet, acid and green "fruity" silage all being recognised as desirable types, whereas sour and musty silage cause much loss, as stock often refuse to eat them. Almost all herbaceous plants, with the exception of those of the cabbage tribe, can be made into silage, though all are not equally suitable. Tares and vetches, mixed with a supporting crop of oats, rye or beans, give most satisfactory results, providing silage of excellent food value, readily eaten by stock. In other parts of the world maize has proved of the greatest value for silage from every aspect, but as it is very sensitive to frost it is necessary, in Great Britain, to select special varieties bred and selected for habits of quick maturity, Saltger's North Dakota and Longfellow being recommended in place of the White Horse Tooth generally grown. Sunflowers, rotation grasses, clovers and meadow grass can all be made into silage when occasion demands, but sunflower silage is less palatable than the others. A silage crop should be cut in a state of maturity rather more advanced than for haymaking, and second crops of seeds may be ensiled just after the corn harvest, maize being left to the last. The best silage results from a crop which is ensiled immediately after cutting, and careful organisation of labour is necessary to attain this end. Care is needed in filling the silo to obtain uniform shrinkage and to avoid undue spoiling and wastage in the upper layers. Various methods are advocated to reduce this wastage, but none seem to be of real economic value, and a suitable cover for the top of a tower silo remains to be invented.

BIG BUD OF THE BLACK CURRANT —We have referred on two occasions (NATURE, May 26, 1923, p 719, and March 22, 1924, p 439) to an experiment being conducted at the Crichton Royal Institution, Dumfries, on the eradication of big bud of the black currant, due to a mite In 1922 the plot of 400 affected bushes was cut down and thoroughly fired The bushes made good growth and flowered in 1923, and again in 1924, but failed to fruit, and have shown marked indications of reversion Finally, last October, 60-80 per cent of the bushes showed re-infection by the mite (Annual Report for 1924, Crichton Royal Institution, Dumfries, p 23) The experiment, therefore, which gave much promise of success during the first year, has proved a failure, and the bushes have now been destroyed

THE CONTROL OF TSETSE FLIES —In the *Bulletin of Entomological Research*, vol 15, Jan 1925, Dr W A Lamborn gives an account of an interesting experiment which he has carried out in Nyasaland In this instance an attempt has been made to ascertain whether it is possible to obtain some measure of control of the species of tsetse fly, *Glossina morsitans*, by artificially increasing the existing numbers of an apparently promising parasite in the fly area The parasite is the small chalcid *Syntomosphyrum glossinæ* Waterst which lays its eggs in the puparia of the Glossina The resulting larvæ devour the tissues of their hosts, thereby destroying them The chalcid is a favourable subject for the experiment, since it is a very prolific and rapid breeder, and is readily dealt with under artificial conditions It has the further advantage of being easily reared from puparia of flesh flies (Sarcophaga) and other Diptera A stock of this parasite was built up in the first instance from eleven females bred out from a single Glossina puparium These parasites were introduced to a number of Sarcophaga puparia, and the resulting chalcids were then utilised to parasitise a still larger number of the host Eventually, a large stock of parasitised puparia were deposited in the breeding places of the tsetse fly, so as to ensure that the emerging chalcids would be liberated in a favourable environment It was estimated that, on an average, 67 examples of the Syntomosphyrum issue from each puparium, and that more than 277,000 parasites (mainly females) had emerged from the distributed examples Prior to the experiment the normal parasitisation of the Glossina in the area under consideration was found to be only 0 4-0 6 per cent In the year following the distribution, the parasitisation had risen to 8 7 per cent This result, although encouraging, is still a far step from having effected a degree of control of real practical value , nevertheless, it suggests that possibly a still larger output of the parasite might be worthy of trial

OBSERVATIONS ON BRITISH COCCIDÆ —Under this title Mr E E Green publishes in the *Entomologist's Monthly Magazine* for February his ninth contribution of the series, on British scale-insects In the present paper four new species are described and figured, and among them *Kuwania pini* n sp is notable as providing the first record of a coccid occurring on pines in the British Isles *Pseudococcus phalaridis* n sp from Frimley, Surrey, is recorded as being preyed upon by the larvæ of a fly which was identified by Mr J E Collin as *Ochthiphila polystigma* This enemy proved so efficient that, a little later on, the particular colony of the new species of coccid had been practically exterminated Mr Green suggests that this fly might possibly prove useful to check the ravages of the allied coccid, *Trionymus sacchari*, upon sugar-cane in Egypt and elsewhere Among other scale-insects the occurrence of *Eriococcus hoheriæ* Mask on *Hoheria populnea* in the Scilly Isles is of interest since it is the first record of this insect being found away from its original home (New Zealand) It has doubtlessly been imported with the plants from that country The many recent additions made to our knowledge of British scale-insects by Mr Green is but one example of how much work there still remains to be accomplished in working out the more obscure families of the British insect fauna

LIGIA NOVÆ-ZEALANDIÆ IN SOUTH AMERICA —Prof C Chilton records (*New Zealand Journ Sci and Technol*, vi p 287, 1924) the occurrence at Valparaiso of the shore isopod, *Ligia novæ-zealandiæ*, a species which is found also in New Zealand and Juan Fernandez These isopods carry their eggs in brood pouches under the body until the young are hatched in a form resembling the adult, and hence it is unlikely that they could cross large tracts of ocean The existence of this species in the three places referred to is held to be additional evidence in support of a former land connexion between them The shore amphipod, *Orchestia chilensis*, which lives under similar conditions to the Ligia, is also found on the shores of Chile, Juan Fernandez, and New Zealand

THE DEVELOPMENT OF THE MALE GENITALIA OF HOMOPTERA —An extensive literature has grown up around the subject of the structure and homologies of the male genitalia of insects The nomenclature of the different parts is highly involved and it is often extremely difficult to trace their homologies in different orders In the *Quarterly Journal of Microscopical Science*, vol 69, part 1, Dec 1924, Dr Hem Singh-Pruthi has an important contribution to this subject with particular reference to the Homoptera In these insects he finds that the male genitalia consist of two pairs of lateral appendages, the sub-genital plates and the parameres, and a median copulatory organ, the ædeagus They are all borne by the ninth abdominal segment They develop from two pairs of appendages only, an outer and an inner, which appear as diverticula of the ventral region of the ninth segment The outer pair develops into the sub-genital plates, and the inner by longitudinal fission becomes two pairs , the inner one of the two pairs so obtained, by the fusion along the median line of its components, forms a single organ, the ædeagus, while the outer is transformed into the parameres Thus the pair of appendages developing into the sub-genital plates does not belong to the eighth segment, as was believed by Kershaw and Muir, but to the ninth , there are no appendages on the eighth in the nymphs or in the adult , nor is there any evidence in favour of these authors' view that the male gonopore in Homoptera, unlike that in most orders of insects, lies between the eighth and ninth sterna , it is in its usual place, behind the ninth sternum The sub-genital plates seem to be the coxites of the ninth sternum , and both the ædeagus and the parameres, derived from a primitively single pair of appendages, correspond to the endopodites

METEOR CRATER, ARIZONA —A letter to the *Engineering and Mining Journal-Press* for February 7, from Mr L F S Holland, superintendent with the Company the recent drilling operations of which under the rim of Meteor Crater have aroused widespread interest, prompts us to refer once more to the origin of this puzzling "crater" (see NATURE, February 14, p 244) Mr Holland is chiefly concerned in correcting the many false impressions that have been spread abroad by enthusiastic but largely misleading journalism. He confirms the presence of platinum in the

iron meteorites of the neighbourhood, giving the average as one ounce of platinum to five tons of meteorite An American Sunday paper has published a photograph of an apparently large diamond alleged to have been embedded in an Arizona meteorite Possibly the magnification was not stated, but the truth of the matter is that, while diamonds do occur, they are invariably of microscopic dimensions Of more importance is Mr Holland's belief that the crater can be best explained by the impact of a shower of meteorites However, he doubts whether the recent boring went far enough to prove or disprove Barringer's latest theory that the main mass of the meteoric shower became embedded under the southern rim at an angle with the surrounding plain

The Petrology of Penmaenmawr —The differentiation of the magma which is now represented by the interesting intrusion of Penmaenmawr is discussed by H C Sargent in a recent paper (Proc Liverpool Geol Soc vol xiv, 1924, pp 82-98) which supplements his earlier work on the various rock-types Below the 1000-foot contour the rock is a very fresh enstatite-porphyrite with labradorite as the dominant mineral Above this level the plagioclase becomes less calcic, gradually reaching oligoclase, while quartz and orthoclase, mainly present as micropegmatite, steadily increase upwards The author ascribes the differentiation to the inhibition of reaction between the earlier-formed crystals and the residual liquid (shown by the existence of zoned felspars), accompanied by the straining-off of the more siliceous and alkaline material in which the volatile constituents would also be concentrated He considers it is not safe to assume that sinking of crystals has been an important process, as the grain-size shows no marked variation with height But the process outlined would not provide an upper concentration of quartz and orthoclase unless the other minerals became concentrated downwards, so that relative movement of crystals and residual liquid is logically implied The influence of volatile fluxes is shown by the increasing turbidity of the felspars as they are traced upwards, by the production of bastite, epidote, and other alteration-products, and by the scarcity of biotite in the higher horizons It is clearly pointed out that these features cannot be due to weathering In the upper part of the adjoining Craig Lwyd area hornblende is abundant, but so far no explanation is forthcoming to explain this mineralógical difference There seems to be a lateral as well as a vertical differentiation, the south-eastern portion being richer in lime and the north-western richer in potash, thus suggesting that the intrusion may have come from the south-east. Part II of the paper, not yet published, may throw further light on these speculations.

The Ages of Radioactive Minerals —The measurement of geological time by methods based on the decay of radioactive substances is now receiving renewed attention in the United States The National Research Council has appointed a committee under the chairmanship of Prof A-C Lane, to investigate the subject, and the committee has performed a valuable preliminary service by issuing a bibliography of the literature by R C Wells In Canada the Geological Survey has assigned to H V Ellsworth the task of applying the methods to Canadian problems A first paper from his pen is now published in the *American Journal of Science* for February 1925, and gives the results of several new analyses, and a valuable discussion of the principles involved Hitherto it has been found that when thorium is a noteworthy constituent of a series of minerals, the lead-ratios derived from them are too variable to be trusted, and the tendency has therefore been to ignore such minerals in the expectation that sooner or later the discrepancies associated with thorium would be explained This course has been followed without detriment to the development of the subject, since for uranium minerals in which thorium was not an important constituent the results have been concordant among themselves and with the geological evidence Ellsworth, however, in calculating the ages of a series of uraninites from the pegmatites of Ontario, has taken thorium fully into consideration with results that are a little more consistent than they would have been had thorium been ignored The ages vary from 1115 to 1189 million years, with an outside figure based on considerably altered material of 1299 million years These values agree very closely with those obtained from minerals of Middle pre-Cambrian age occurring in Scandinavia, Africa, India, and the United States Before any further advance can be made, apart from the accumulation of analyses, it is essential that the half-periods of thorium and uranium should be re-investigated in relation to the possibility of isotopes of the parent elements, and that the genetic connexion of thorium and uranium, if there be one, or has been one, should be disentangled from the conflicting evidence

Velocity of Diffusion, Viscosity, and External Pressure —Messrs E Cohen and H R Bruins describe, in the *Zeitschrift fur physikalische Chemie*, January 20, a new apparatus for determining the viscosity of mercury at high pressures The ratio of the viscosity at 1500 atmospheres pressure to that at one atmosphere is found to be 1 048, at temperature 20° C In their previous investigation into the effect of pressure on the velocity of diffusion of cadmium in mercury, at the above temperature, it was found that the ratio of the velocity of diffusion at one atmosphere to that at 1500 atmospheres is 1 051 It follows then that, within the limits of accuracy of the diffusion measurements, the product of the viscosity and velocity of diffusion is the same at one and at 1500 atmospheres This agrees with the results of previous investigations of the authors, which showed that the velocity of diffusion at atmospheric pressure was inversely proportional to the viscosity, even when the molecules of the diffusing substance and of the medium into which diffusion took place were of equal size.

Stark Effect in Metallic Arcs —In the *Japanese Journal of Physics*, vol 3, p 45, H Nagaoka and Y Sugiura describe an investigation of the Stark effect produced in the electric arc for a number of metals It was first necessary to stabilise the arc, and this was done by introducing a capacity of more than one microfarad and a large self-inductance between the electrodes, and using a P D of 500 volts obtained from a direct current generator By employing carbon as the cathode and the metal under test as the anode, arcs of 7 cm in length were maintained with perfect steadiness The potential changes along the arc were examined, and the electrodes were found to be the seats of strong electric fields due to the presence of an electric double layer which is formed when the current surpasses a critical value Using a small drop of metal at the anode, fields of the order of 10^6 volts per cm were obtained, and the Stark effects in these fields were studied It was found that, with several metals, lines belonging to the same spectrum series were similarly affected, the nature of the change being different for different series, and that the effect increased with the term number

Mining Research.

THE Executive Board of Mining Research of the University of Birmingham has just issued a report on the work of the Mining Research Laboratory for the years 1921–1924, the report being signed by Dr. J S Haldane, who is the chairman of this Board The report gives an interesting summary of the various researches which are being undertaken, some of which deal with problems of very great importance to the coal industry Necessarily some of these researches are purely scientific, whilst others are essentially practical, but it is quite obvious that the results of even the first named are likely to find important practical applications A great deal of work has been done upon the absorption of various gases by coal, and the effect that these phenomena may have upon the spontaneous combustion of coal has been carefully investigated A certain amount of work has been done on the application of wireless electricity to underground problems, but no definite conclusions appear to have been reached, and the work has, for the present at any rate, been laid aside. A most interesting group of physiological experiments has been carried out by means of an experimental chamber by which it is possible to test the effect of various gases upon men at rest and at work, as the result of these experiments, accurate information as to the effect of carbon monoxide upon those exposed to its influence has been rendered available, and it has been shown that this poisonous gas is absorbed far more readily by men doing work than when they are at rest Another series of these experiments has tested the suggested new method of treatment for carbon monoxide poisoning as well as for asphyxiation, the value of carbon dioxide for this purpose having been shown by these researches, with which the name of Dr Haldane is closely associated

Another set of researches, the ultimate results of which may be of very far-reaching importance, are those upon the discoveries of Dr Bergius dealing with the hydrogenation of coal It has been found that when coal is mixed with a suitable liquid such as phenol, and heated to approximately 400° C in an atmosphere of hydrogen under a pressure of 155 atmospheres for a considerable length of time, hydrogen is absorbed and a quantity of coal, in some cases up to 40 per cent, is converted into an oil-like liquid The various constituents of coal have been tested, and it is found that clarain and durain are hydrogenated with comparative facility, but that fusain is very little affected The possibility of hydrogenating coal under these conditions has thus been definitely confirmed, and substantial yields of liquid products have been obtained, though the nature of these liquids has not yet been fully investigated, it is stated that they appear to contain oxygen, and that it is a question yet to be determined whether it is possible to eliminate this oxygen by further hydrogenation and thus to obtain hydrocarbons Attention is directed to the fact that the behaviour of clarain and durain is approximately the same, and that the liquids obtained by treating these constituents give almost identical analytical results, and it is suggested that this fact would appear to support Prof Wheeler's contention that clarain and durain contain constituents of similar chemical type Although up to the present the results obtained by the hydrogenation of coal have a purely scientific interest, it must be remembered that they only represent the initial stages of a very complex investigation, and that it is quite possible that the ultimate outcome of this may produce results of the utmost economic importance

Researches on the spontaneous combustion of coal have occupied a considerable portion of the work of the Mining Research Laboratory It will be remembered by those interested that the Mining Research Laboratory of the University of Birmingham was established to continue the work originally started in the Doncaster Research Laboratory, which was established with the definite object of investigating spontaneous fires in the collieries of that district It is, however, only proper to point out that whilst the investigation was due in the first instance to the necessity for combating the dangers to which the coal of the district was especially liable, the Doncaster Coal Owners' Committee from the outset placed all its laboratory results freely and fully at the disposal of the entire coal mining industry, and took care to publish all the results obtained by its laboratory staff This work has been continued at Birmingham, and the oxidisability of different types of coal has been recently studied, as also has the liability of the various constituents of coal to spontaneous combustion The results have clearly shown that fusain is relatively insensible chemically, and that its oxidation is negligible as a source of heat in initiating spontaneous combustion On the other hand, it is pointed out that bands of fusain, on account of their open physical structure, may play an important part in aiding spontaneous combustion by forming channels through which supplies of air can readily reach the more oxidisable constituents of the coal

A number of researches, all bearing on the investigation of the oxidation of coal, are being carried on, and it is worth noting that they are being assisted by a grant from the Miners' Welfare Fund, made on the recommendation of the Safety in Mines Research Board of the Mines Department It is, of course, of the greatest importance to the industry that all the mining research now carried on throughout Great Britain should be co-ordinated by a central authority, not with the view of controlling the work, but mainly to see that no excessive overlapping occurs and to take care that provision may be made for filling up any important gaps in our knowledge which may be left between a number of individual lines of research It is interesting to note that a number of respirators, most of which have originated in the United States, and are designed to enable men to live for a certain time in an atmosphere of carbonic oxide by oxidising this gas to the relatively innocuous carbonic acid, have been examined, and the results are now being published in the Transactions of the Institution of Mining Engineers

Finally, we have a group of researches conducted in order to determine the effect of specially hot and deep mines, this work now being carried out in conjunction with a committee of the Institution of Mining Engineers, financed by grants from the Department of Scientific and Industrial Research and the Miners' Welfare Committee on the recommendation of the Safety in Mines Research Board of the Mines Department Nine reports have already been published as communications to the Institution of Mining Engineers, a form in which they are conveniently available for men engaged in mining operations in all parts of the world The work is being continued, and there is still a large field open for research

It will be obvious from this brief summary of the report that the Mining Research Laboratory of the University of Birmingham is doing work of the utmost value to the mining industry, by far the greater part of this work bears directly upon the safety, health, and welfare of men engaged in the coal mining industry

Diagnosis of Ankylostomiasis.

THE publication before us[1] aims at giving a connected account of copious and careful work already published in the *Indian Journal of Medical Research*, and since in certain instances it is only the conclusions originally drawn which are now reproduced, their validity cannot be estimated except by reference to the original record

Since all scientific work on ankylostomiasis must rest on accurate diagnosis, great attention is paid to the direct methods by which this is obtainable, namely, to detection of ova and collecting of worms The former was undertaken mainly by microscopic examination of the centrifugal deposit from a strained fæcal suspension, but partly by a special modification of the commonly used concentrative principle inherent in the employment of a heavy salt solution in which hookworm ova float and other fæcal matter sinks

For the particular floatation technique described, it is claimed that it loses only 7 per cent of ova as against a loss of 50 per cent. or more entailed by other methods, the control employed being apparently the first-mentioned technique Regarding the control, Mhaskar himself finds it inaccurate in that, in the one instance noted, subsequent floating of a counted smear increased the countable ova by 14 per cent The extraordinary inadequacy of these controlling counts is, however, shown by the reviewer's figures, hitherto undisputed, indicating that the average addition required to this particular form of control is not 14 but more than 30 per cent He finds, too (the report is now in the press), that in his hands Mhaskar's floatation technique indicates an ovum content from one-tenth to one-sixth of that which another, namely, direct centrifugal floatation, shows to be certainly present

It is of interest to refer here to a compilation by Dr. Khalil,[2] who advocates a technique embodying yet another modification of the floatation principle, a saturated solution of common salt being used to float up ova in the inverted cone formed by an Erlenmeyer flask, coarse fæcal matter having first been strained off through a fine sieve. Clearly the intention is that the rising hookworm eggs should become concentrated upon a small area, their removal to a small examination area being thus facilitated The technique is held to ensure detection of mild infections It is entirely uncontrolled

Now the only recorded effort hitherto made (by the present reviewer) to control the effects of floatation in an inverted cone showed that the number of ova recovered from the surface was, on the average, one-tenth of those which a control count indicated as present in the fæces employed, and it has since been shown, as noted above, that that particular control underestimated the ovum content by an average of more than 30 per cent It is not then possible, without evidence offered of the ovum content of the fæces used, to accept as accurate this new gravity floatation method in an inverted cone Presumption of its inaccuracy lies in the many instances here reported where it detected a solitary ovum, whereas, as the available evidence suggests, there were indeed present some twenty or thirty, detectable by adequate means, and in the fact that while 40,000 examinations by the admittedly inadequate smear or centrifugal precipitation methods showed an infection percentage in different parts of lower Egypt of 48 to 97, that obtained in the one village tested by the new technique was only 16 6

The particular importance of accurate and controlled examinations in Egypt lies in its being apparently the only country in the world where extensive human hookworm infection is limited to *Ancylostoma duodenale* It offers, therefore, unique opportunities for determining whether, as, for example, in ovum output and reaction to treatment, ancylostomiasis and necatoriasis differ—whether there be one ankylostomiasis or two

Regarding diagnosis by collecting the worms passed after the administration of an anthelmintic, Mhaskar failed to find males in a tenth of cases which were passing fertile eggs, and females in 71 6 per cent of 500 cases, also passing fertile eggs His conclusion that intensity of infection cannot be gauged by the number of ova found on a slide, though inevitable on his premises, is not necessarily correct

It is further concluded, without qualification, that betanaphthol thymol and carbon tetrachloride have a fleeting effect on oviposition, their administration rendering diagnosis by search for ova untrustworthy for four days But the original table, if analysed, shows that in 227 cases treated, 129, or 57 per cent, were not cured, and of the uncured 18, or 14 per cent only, showed this temporary inability of the diagnostic method employed to detect ova On the other hand, of the 98 cases reasonably presumed cured (for ova were not found in their stools after the third day) 48, or 51 per cent, showed ova during one or more of the first three days Clearly all factors have not been considered in drawing these conclusions

The line of treatment used for tea estate labour illustrates vividly the features of the procedure at present fashionable In one group of estates there was instituted the popular mass treatment without diagnosis Betanaphthol was administered by scooping it up in a measured spoon It was concluded that as regards 50 grain doses for an adult "it is safe, and even a mistake in excess of the maximum dosage advised is not followed by any serious inconvenience, not much care is required in prescribing this drug, nor is any after-supervision necessary" There is no cross reference under this comment to the following incident On the next set of tea estates, examination of 104 fæcal specimens showed 94 infected Mass treatment was accordingly administered without further diagnostic examinations Of 1400 persons treated as described with betanaphthol, 2 died and 37 became gravely ill, with the symptoms of poisoning already described in the *Indian Medical Gazette* by Orme and by Corteling, and for Brazil by Smillie Two men, that is, died of poisoning by a drug administered for an infestation, of their individual possession of which there is no evidence The betanaphthol was proved to be chemically pure

In the matter of prevention, which is of course summed up in the word soil-infection, it is shown that larvæ identified as those of hookworms persisted in trenched nightsoil for 13 to 14 weeks, and in the surrounding soil for 6 to 9 weeks, but it is concluded that larvæ do not migrate from the place of development Larvæ found in the soil after 16 weeks were held in all cases to be non-parasitic, for it is stated that, apparently in some 14 experiments, counted numbers of these larvæ were placed in a drop of water left lying on the skin of the forearm for half an hour, and that every one of these larvæ was afterwards pipetted off and accounted for

The valuable work here detailed merits close examination, however much one may feel compelled to dissent from the main conclusions

CLAYTON LANE

[1] Report of the Ankylostomiasis Inquiry in Madras By K. H Mhaskar Indian Medical Research Memoirs, Volume No 1 October 1924

[2] Ankylostomiasis and Bilharziasis in Egypt Reports and Notes of the Public Health Laboratories, Cairo, No 6 30 P T

University and Educational Intelligence.

CAMBRIDGE.—The report of the Appointments Board for the year 1924 presents interesting reading. The number of appointments found for graduates of the University has increased to 400. The chief groups are educational appointments, 123; manufacturing and technical appointments, 103; administrative appointments in commerce and industry, 90; agriculture and forestry, 25; and colonial administration, 16. The board notes a dearth of candidates for the great public services overseas.

The annual report of the General Board of Studies on the progress and condition of certain University departments for the year 1923-24 refers to a number of facts already noted in these columns. A general slight decrease in the number of students in the scientific departments is noted. Sir Frederick Gowland Hopkins points out that the amount available for research from the Dunn Bequest, 2400*l.* per annum, did not suffice to meet the needs of his 40 research workers and that the maintenance of research on this scale had involved his department in financial difficulties. Prof. Seward reports his inability to find money for the stipend of the curator of the Botanical Museum. Prof. Inglis reports that arrangements have been completed for the course for officers of the Royal Engineers to be extended to two years so that these officers would take the Mechanical Sciences Tripos. Prof. Dean emphasises the value in the teaching of pathology of its recognition as a subject in Part II. of the Natural Sciences Tripos. It has brought the subject from the pass standard of the medical curriculum to the honours standard of the Tripos. Increased accommodation has led to much improvement in the arrangements of the Museum of Zoology, especially in the case of the entomological collections.

Sir Humphry Davy Rolleston, Bt., president of the Royal College of Physicians, has been appointed Regius professor of physic in succession to the Right Hon. Sir Thomas Clifford Allbutt.

EDINBURGH.—At the meeting of the University Court on March 16, intimation was made that His Majesty, on the advice of the Secretary for Scotland, had appointed Dr. John Fraser to be Regius professor of clinical surgery in succession to Sir Harold Stiles, who resigned on March 20.

Leave of absence for May and June was granted to the professor of materia medica to enable him to deliver the Dohme Memorial Lectures at Johns Hopkins University, Baltimore. Prof. Cushny proposes to deal in these lectures with the subject of optical isomers in biology.

The Munro Lectures on anthropology and prehistoric archæology will be delivered by Sir Arthur Keith in May next.

Mr. K. G. Fenelon, lecturer in economics, was appointed in connexion with the educational courses for railway staffs to deliver the course of lectures for 1925–26, the subject being railway economics.

A letter was received from the Forestry Commission stating that the Commissioners had had under consideration the question of mycology in relation to forestry work, that they regarded it as a matter of urgency that a means should be found to combat fungoid diseases, which were causing the department serious loss in its nurseries and young plantations, and that they were prepared to make to the University in respect of the year commencing April 1 next a grant not exceeding 500*l.* for research in this connexion to be carried out by the Botanical Department of the University. The Court welcomed the proposal and concurred in the arrangements suggested.

LONDON.—Keddey Fletcher-Warr Studentships, each of the value of 200*l.* a year for three years, have been awarded to Mr. D. C. Harrison (King's College), for research in biochemistry, and to Dr. N. A. V. Piercy (East London College), for research in aeronautics.

ST. ANDREWS.—At a meeting of the University Court on Friday, March 20, Mr. William W. McClelland, principal lecturer in education in Edinburgh Training Centre and lecturer in the University of Edinburgh, was appointed to the Bell chair of education, the duties of the chair embracing the University lectures in education at St. Andrews and Dundee. Prof. McClelland will also act as Director of the St. Andrews Provincial Committee for the Training of Teachers.

Prof. A. E. Taylor, formerly professor of moral philosophy at St. Andrews, now occupying the chair of moral philosophy at Edinburgh, has been appointed to deliver the Gifford Lectures in the session 1926–1927.

THE governing body of the Northampton Polytechnic Institute, St. John Street, Clerkenwell, E.C.1, is inviting applications for the headship of the electrical engineering department. Particulars of the appointment and forms of application are obtainable from the principal. Completed forms must be returned by April 18 at latest.

A SENIOR lecturer in dental anatomy, physiology, and histology will shortly be appointed by the University of the Witwatersrand, Johannesburg. Particulars and forms of application may be had from the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2. Completed forms and testimonials (in each case three in number) must be sent in by April 11 at latest.

A REPORT on facilities for advanced study and research in the universities and university colleges of England and Wales is published in the March number of the *University Bulletin*, the organ of the Association of University Teachers. The report is the work of a committee comprising the Principal of the University of St. Andrews and nine professors of the Universities of Oxford, Cambridge, London, Leeds, Liverpool, Sheffield, and Bristol, the Imperial College of Science and the University College of Wales. The committee adduces the usual reasons for the improvement of salaries, the lightening of the teachers' load of routine work, and the granting of special leave of absence for the purpose of pursuing an investigation or completing a piece of original work, and states that no teacher should be expected to give more than half his working day to routine University duties. It is suggested that in each territorial region a joint body representing the University and the secondary schools of that region might with advantage be set up for the purposes of such co-ordination of curricula and adjustment of university entrance requirements as would tend to free the universities for their proper work. The institution of research professorships is regarded with disfavour by all the local branches of the association, and the committee agrees that it is not to be recommended as a general policy though useful in special circumstances. Special attention is directed to the policy adopted by the University of Birmingham of maintaining a research fund administered by a joint standing committee. The same number of the *Bulletin* contains articles on library co-operation, examinations, the University of London, and income tax on salary earned abroad—showing that this journal no longer confines itself mainly to recording the activities of the Association of University Teachers.

Early Science at Oxford.

March 30, 1686. Dr Plot communicated coal from Amrath in Pembrokeshire, which being spit on gave an Ink for writing, as was found true by experiment before ye Society

March 31, 1685. Mr President was pleased to give the Society a more full account of his extracting the Root of a Number of 53 places in the darke, by the help of Memory

Upon occasion of a Discourse at a meeting of the Philosophicall Society at Oxford (March 24, 1684–5) concerning the advantage, which those may have (as to Memory, & the application thereof) who want their sight, Dr Wallis confirmed it by this consideration, that even we, that have our eye-sight, can yet with more advantage apply our Memory (in matters of intent consideration) by night, in the dark, when all things are quiet, than by day, when sights and noises are apt to divert our thoughts And gave instance in his application of his own memory, by night, (in performing Arithmeticall operations in great numbers) better, than by day he could have done: and, even by day, we may better do it with our eyes shut, than open

Having had the curiosity heretofore to try, how far ye strength of Memory would suffice me to performe some Arithmeticall Operations (as Multiplication, Division, Extraction of Roots &c) without the assistance of Pen, & Ink, or ought equivalent thereunto; And finding it to succeed well for instance in extracting the Square Root from numbers of 8, 10, 12, or more places I proceeded to try it (with successe) in numbers of 20, 30, or 40 places On December ye 22d, 1669, I had (by night, in the darke) extracted the Square Root of 3 (with cyphers adjoyn'd) continued to ye twentieth place of Decimall Fractions I did that same night (by darke, in bed, without any other assistance, than my memory) propose to my self (at all adventures) this Number of 53 places

2,4681, 3579, 1012, 1411, 1315, 1618, 2017, 1921, 2224, 2628, 3023, 2527, 2931,

and found its Square Root of 27 places to be

157, 1030, 1687, 1482, 8058, 1715, 2171 feré

These numbers (having fixed them in my Memory, by repeating the same operation a night or two after) when a friend made me another visit, March 11th following, I did dictate to him from my memory (having not before committed them to writing) for him to write down and examine And did afterwards write them down myself

April 3, 1688 Mr Walker shewed the Society some drop Microscopes, and the manner of makeing them

Mr Charlet acquainted the Society of a Cock with three legs, and two anus's at William Greenhill's Esqr at Abbots Langley near St Albans

Several formed Stones were shewed the Society viz *Cornua Ammonis, Mytiloides, Solenites, Conchites*, several Stones called St Cuthbert-beads, and other stones exactly of the figure of a Cocks Spur, which, as Dr Plot related, are only the pointes of those Stones called St Cuthbert-beads, most of which were found in the Quarries on the side of Wotton-under-hedg-Hill in Glocestershire, as also a great hollow mass of Iron Oar, brought from St Vincents Rocks near Bristol, which in the concave was beset with hexangular crystalls, as also some masses of Lead Oar Oar found on Lye-Down near Bristoll, from which it is said they extract Silver in a Cup alle standing under the aforesaid Down

Upon the sight of which the President acquainted the Society that at Stanton-Prior *Cornua Ammonis* were the natural stones of ye place

Societies and Academies.

London

Royal Society, March 19—Sir William **Hardy** and Ida **Bircumshaw**. Boundary lubrication plane surfaces and the limitations of Amontons' law (Bakerian Lecture) When the slider has a plane face the coefficient of friction is a function of the load, decreasing as the load increases, until a point is reached beyond which the coefficient is independent of the load When it has a spherical face, the coefficient is always independent of the load The coefficient is a measure of the efficiency of the lubricating layer with respect to one variable—the load Recollecting that the pressure between the bearing surfaces must be very great when the slider has a spherical face, the above results show that with low pressure the efficiency of the lubricant increases as the pressure increases until a limit is reached, beyond which Amontons' law holds It is probable that, during the first period, when Amontons' law does not hold, the slider is floating on a layer of lubricant the thickness of which is a function of the pressure, whilst in the second period, where Amontons' law holds, all lubricant which can be squeezed out has been squeezed out, and a layer of constant molecular composition has been reached In the first period friction is adjusted to the load by variations in the thickness of the layer of lubricant, and in the second period by the elastic forces between the atoms

Linnean Society, February 5—G P **Bidder** Growth and death A water-borne organism may grow indefinitely, but swiftly moving land-animals must maintain a relation between their weight and the cross-sectional area of their bones and muscles Men and plaice before puberty alike show additions to their weight in approximately geometrical progression for equal intervals of time, alike after sexual maturity they show an approximately arithmetical progression In the plaice the annual increment remains to a great age positive In man the arithmetical progression shows a difference with negative sign, and from 28 (the age of greatest reproductive fertility) onwards there appears to be a constant net loss of protein material, amounting annually to ($0{\cdot}8 \pm 0{\cdot}15$) per cent of its weight at 28 The mechanism of the adult body is set after sexual maturity to a certain annual balance of profit and loss for water-borne animals this may be a positive increment and life may be eternal; for terrestrial animals the length of life depends on the nearness to equality of profit and loss A positive annual increment, however small, will eventually bring about death from gigantism, it is not improbable that this has been, and possibly is now, the form of death in some quadrupeds A negative annual increment, however small, determines a date at which all capital resources will disappear We die, therefore, as an alternative to becoming giants

Faraday Society, February 16—A J **Allmand** and V S **Puri** The effect of superposed alternating current on the anodic solution of gold in hydrochloric acid The only well-known case in which a superposed alternating current is used in technical electrolysis is furnished by the Wohlwill modified gold refining process Pure gold anodes in hydrochloric acid solution were employed, using direct current alone, and also the same with alternating current superposed Anode potentials have been measured throughout—C H **Desch** and Eileen M **Vellan**: The electrolytic deposition of cadmium and other metals on aluminium Where lightness is of importance, as

in aeronautical work, the deposit should be thin, and the choice of metals is further limited by the tendency of many deposits to detach themselves Preliminary experiments having shown that cadmium was better in these respects than copper or nickel, an investigation into the best conditions of deposition was undertaken Other methods of protection are on the whole more useful, but comparison with other metallic coatings shows a great superiority in favour of cadmium, even under the severe test of exposure to a salt spray The deposit has a pleasing appearance and a good colour —W M **Thornton** and J A **Harle** The electrolytic corrosion of ferrous metals The most direct way of subjecting a metal to the influence of active moist gas is by electrolysis Since rust is almost entirely oxide, it is only necessary to make the specimen the anode of a cell containing slightly acidulated water in order to obtain conditions of exposure to moist oxygen which are perfectly under control Not only have pure metals definite rates of corrosion according to Faraday's laws, but also every ferrous alloy examined has a specific rate of electrolytic corrosion by which it can be identified with certainty This may prove a basis for a systematic comparison of the behaviour of ferrous alloys under all conditions of exposure which result in oxidation —S **Glasstone** Overvoltage and surface forces at the lead cathode The addition of ethyl or methyl alcohol, or acetic acid, to aqueous solutions with various hydrogen ion concentrations lowers the surface tension and also the overvoltage Substances like iso-amyl alcohol, which are sparingly soluble in water and lower its surface tension considerably, cause the overvoltage of a lead cathode first to increase and then to decrease as increasing amounts are added A complete theory of overvoltage must take into account the surface forces involved in bubble formation —M **Shikata** The electrolysis of nitrobenzene with the mercury-dropping cathode Part I The reduction potential of nitrobenzene Nernst's formula, modified by the adsorption isotherm, was verified in acid and alkaline solutions An abnormal reduction potential in alkaline solution was found and " neutral salt actions " were observed The reduction due to the simple deposition of hydrions, and to the ionic splitting of water in neutral solutions, was distinguished by the current-voltage curves Part II The influence of the cathodic potential on the adsorption of nitrobenzene A maximum reduction current followed by a minimum, due to certain potentials, were observed in the reduction of nitrobenzene The formation of a maximum reduction current was explained by the de-sorption due to the applied polarisation potential of the mercury drops Observed influences of neutral salts upon the R P and on adsorption were explained by the " salting-out " action The method is applicable to quantitative and qualitative micro-analysis —J R H **Coutts** The law of distribution of particles in colloidal suspensions a note on the specific volume of a gamboge suspension Measurements of the specific volume of a dilute gamboge suspension, to an accuracy of about 1 in 60,000, verified the assumption made by Porter and Hedges, namely, that no significant contraction or expansion takes place in the formation of such a suspension —W W **Barkas** On the distribution of particles in colloidal suspensions The results of measurements made in centrifuged solutions of gamboge, silver and copper, of the sizes of particles given by the formula of Porter and Hedges as compared with the sizes given by the law of centrifuging developed by E Talbot Paris, are discussed The same values of the radius are given for copper by the two methods, for silver the radius from the distribution is higher, and for gamboge lower than from the centrifuge The radius given from the distribution of uncentrifuged solutions is in similar agreement with that given from the rate of fall of the cloud particles by Stokes's Law If the solution under examination could be effectively shielded from changes in temperature, the determination of the distribution would give an accurate measure of the mean size of the particles in a solution, provided their density was known Over a considerable range of concentrations, the level at which the distribution is sensibly uniform is quickly reached and the limiting concentration is directly proportional to the number of particles present in the solution

Royal Statistical Society, February 17 —E S **Russell** and T **Edser** The fishery statistics of England and Wales The number of fishermen engaged in the sea industry is about 40,000, and all the waters of the continental slope, from the Barents Sea down to the Atlantic coast of Morocco, are visited by English trawlers in their search for fish, and to the north-westward the waters round Iceland and Faroe are regularly frequented The value in 1923 of the catch of bottom-living or demersal fish, the great bulk of which is brought in by steam trawlers, was 12,500,000*l* To this must be added the value of a catch of pelagic or surface-living fish caught mainly by drift nets, which amounted in 1923 to 1,500,000*l* The principal pelagic fish is the herring, of which more than 3,000,000 cwt was landed in 1923 Statistics of real value date back to 1886, and marked improvements were made in 1903 and 1906 It is now possible to allot catches to rectangular areas of 1° of longitude by 1° of latitude, and the catch per 100 hours' fishing can be worked out for steam trawlers and certain other classes of vessels An international system of groups of these rectangular areas has been evolved and is accepted by the nations adhering to the International Council for the Exploration of the Sea

Royal Meteorological Society, February 18 —Miss L D **Sawyer** The effect of pressure distribution upon London's sunshine in winter The results were based on an analysis of the pressure types during the five winters ending 1921-22, and the amount of sunshine recorded in different parts of London each day Near the centre of a depression the average sunshine is less than 0 5 h per day, and near the centre of an anticyclone the figures are equally poor except with E S E breezes If the pressure centre is at least two or three hundred miles away, the average with anticyclonic conditions is about two and a half times as great as with cyclonic, while a " neutral distribution " (neither cyclonic nor anticyclonic) is almost as sunny Records show that Hampstead and Greenwich are both almost as sunny as South Farnborough when the air reaches them before passing over London, but Hampstead loses more than an hour a day with S E winds and Greenwich as much or more with N.W winds —S **Chapman** On the changes of temperature in the lower atmosphere, by eddy conduction and otherwise For a number of years hourly observations of the temperature of the air have been made on the Eiffel Tower, at the base, the top, and two intermediate heights, *i e* of the change of temperature in the lowest stratum of the atmosphere, 300 metres, or nearly 1000 ft thick Eddy conduction is not the predominant cause of the temperature changes, and the effect of the remaining (major) cause, probably radiation, is far from being constant with respect to height The temperature changes wrought by conduction are greatest at midday and small at night, those produced by radiation are greatest soon after dawn (when the air is being heated rapidly) and

in the late afternoon (when the air is cooling) —N K **Johnson** and O F T **Roberts** The measurement of the lapse rate by an optical method Theoretical expressions have been deduced by various authors connecting the apparent vertical displacement of a horizontal ray with the length of the ray path and the vertical gradient of temperature in the atmosphere The results of the observations confirm the theory within the limits of accuracy of the measurements With certain limitations, the optical method affords a practical means of determining the vertical gradient of temperature

Geological Society, February 20 —J W **Evans** Regions of tension, evidenced by joints, slip-faults, and dykes (Anniversary Address) The different causes of local tension were given, including torsion, but although the latter was found by Daubrée to give systems of fractures at right angles to one another, these might also be produced in any area with maximum and minimum directions of tension Western Europe is largely characterised by tension towards the south-west, but north-westward tension prevailed in north-western Ireland and north-western Scotland The south-westward tension appears to represent a slow drift towards the Atlantic " deep " in the Bay of Biscay running north-westwards from Cap Breton, and the north-westward tension seems to represent a drift towards the " deep " trending north-eastwards between Rockall and Ireland These " deeps " themselves are to be attributed, not to " foundering," but to a drift of the " sial " masses of the Central Atlantic banks to the south-west and north-west respectively

Edinburgh.

Royal Society, February 9 —W L **Calderwood** The relation of sea growth to the spawning frequency in *Salmo salar* From the systematic study of scales of salmon and the calculation of age lengths, the growth of fish which return from the sea to spawn in early life is contrasted with the growth of those which remain for several successive years to feed and grow to a large size without spawning The first and frequently the second year's growth in the sea determines which habit is followed —F J **Cole** A monograph of the general morphology of the myxinoid fishes based on a study of Myxine Part VI Blood vascular and lymphatic systems of Myxine The anatomical relations of the two systems and the circulation of the blood from one to the other is described An extensive true lymphatic system is present as apart from the so-called veno-lymphatics which belong strictly to the venous system A fourth (cardinal) heart is described The liver is an hepato-pancreas, the pancreatic tubules being associated with the branches of the portal vein in the liver parenchyma —Sir Thomas **Muir** Theory of compound determinants from 1900 to 1920

Manchester.

Literary and Philosophical Society, February 3 — W L **Bragg** (1) Model illustrating the formation of crystals When a solution of a salt is evaporated, positively and negatively charged ions, which are at first distributed in the solutions, pack themselves into a regular pattern A series of electro-magnets hung by long wires represent these ions They can be charged with opposite polarities by passing an electric current through them At first they swing about freely in all directions, then as the attractive force increases they group themselves into pairs (molecules), and these pairs pack together to form a regular crystalline body in two dimensions A slight variation of the experiment shows the difference between acids and bases and the formation of complex acid groups according to the theory of Kossel. (2) Exhibit of diffraction gratings constructed to illustrate the effect of crystals on X-rays. By ruling gratings in which the lines are complex, many of the diffraction effects observed in crystals may be simulated The gratings are made by taking a contact print from a glass plate ruled with a number of fine lines such as is made for the half-tone printing process Instead of taking one print, two or more are taken, the plate being moved a very small distance between each exposure, and the times of exposure varied. Thus each line in the grating has several components of different intensities just as each molecule in the crystal is composed of several atoms, all the components or atoms scattering the light or X-rays respectively Very striking diffraction effects exactly like those got in X-ray analysis are obtained — R W **James** and W A **Wood** The structure of barium sulphate Examination of the spacings of the different planes shows that the space-group is V_h^{16} and that the unit cell contains four molecules and has the dimensions $a = 8\ 852$ Å, $b = 5\ 430$ Å, $c = 7\ 132$ Å By examining the intensities of the different spectra it has been possible to place the atoms with some accuracy The intensities of the spectra of lower order are consistent with the assumption that the SO_4 group is a tetrahedral arrangement of oxygen atoms around a central sulphur atom, the distance sulphur to oxygen being about 1 5 Å The barium and sulphur atoms lie on the reflexion symmetry planes of the structure which are parallel to (010), and necessarily two of the oxygen atoms lie on these planes also —E C S **Dickson** Experimental demonstration of the Magnus effect principle of the Flettner rotor ship

Paris.

Academy of Sciences. February 9 —Charles **Richet**, M **Oxner**, and J **Richard** Cooked food and raw food in feeding fish An account of experiments carried out at the Oceanographic Institute of Monaco on *Cantharus griseus* The fish fed on raw meat showed no differences from those fed on cooked meat up to the 50th day, but after that period the former steadily gained in weight on the latter —H **Vincent** The pathogeny and conditions of maintenance of the coli bacillus The blood of animals immunised against the *B coli communis* is rich in the antibody, but the urine contains little or none The immunity does not extend to the kidney or bladder —G **Friedel** Remarks on a recent communication relating to the fatty acids With reference to a recent note of M Trillat, the author emphasises that the smectic state as defined by him is very different from the crystalline state, and the term cannot be applied to crystals —Georges **Giraud** The generalised problem of Dirichlet, Non-linear equations of *m* variables — F **Defourneaux** Some applications of electrospherical polynomials to the theory of numbers —Maurice **Fréchet** Abstract spaces —Vladimir de **Belaevsky** The rupture of the Bouzey dam The deformations of a reduced model ($\frac{1}{500}$) of the Bouzey dam constructed in xylonite have been studied by an optical interference method From the results of the measurement the conclusion is drawn that the bursting of the Bouzey dam in 1895 was produced by rending —Henri **Malet** The idea of the variation of mass, deduced from the formula of the addition of the velocities taken by itself —Maurice **Le Besnerais** and Raoul **Ferrier** The electrical constitution of the ether —Marcus **Brutzkus** The realisation of chemical reactions in compressors —

F Croze The structure of the line spectrum of ionised oxygen —B Szilard A new method of examining the interior of pearls The pearls, immersed in thick cedar oil, are viewed directly by the microscope Pearls formed on a nucleus of mother of pearl can be readily distinguished by this method from natural pearls —Nobuo Yamada Particles from polonium with a long path —Fred Vlès and Edmund Vellinger The physico-chemical properties of gelatin, the rotatory power The results of measurements of diffusion, multi-rotation and rotatory powers of solutions of gelatin are given, the variable being the hydrogen ion concentration ——Lespieau The glycol CH C CH(OH) CH_2 (OH) This glycol was obtained from the chlorhydrin CH C $CH(OH)_2$. CHCl as starting point, through the ethylene oxide CH C $\overset{\diagup O \diagdown}{CH_2—CH_2}$ Its formula was established by its combination with phenyl isocyanate and by titration with bromine It is remarkable as being the first true acetylene derivative failing to give a precipitate with ammoniacal cuprous chloride —Marcel Godchot Octohydro-phenazine —Charles Chéneveau. The formation of natural dull amber A transparent pine resin can be rendered opaque by treatment with water at 50° C, under similar conditions peach and cherry gums do not turn opaque, but swell up and form a gel During the tertiary period the influence of the temperature of the Baltic regions, then tropical, together with the effect of time, would be sufficient in the presence of water at atmospheric pressure to convert the transparent resin into opaque resin —L Royer New observations on the orientation of ammonium iodide by muscovite mica —Ch Lormand Analysis of the thermal waters of Chaudesaigues (Cantal) — C Dauzère The atmospheric vase and the sea of clouds Observations made at the Pic du Midi —R Kuhner The nature of the cystids in the Basidismycetes —A Hée and R Bonnet The influence of the dissolved oxygen content of the water on the respiration of submerged plants For the four species of plants studied (*Myriophyllum epicatum, Elodea densa, Cabomba caroliniana, Elodea canadensis*) the intensity of the respiration was not sensibly modified by variations in the dissolved oxygen in the water between 3 cc and 24 cc of oxygen per litre —E Michel-Durand Under what form do the tannins exist in Spirogyra? The tannins of these plants are almost completely extracted by acetone and amount to about 3 per cent of the dry weight The insoluble tannin compounds, normal in higher plants, are absent from Spirogyra —Henri Piéron The differential characteristics of the working of the retinal cones and rods —Jules Amar The stages of vital coagulation —Jean Roche The respiration of the tissues in avitaminosis and inanition A recent theory, put forward independently by Hess and Abderhalden, attributes to the vitamins a rôle of primary importance in the mechanism of cellular oxidations According to this theory, avitaminosis is an impoverishment of the cells in respiratory ferments Experiments on tissue respiration described have given results in opposition to this theory —P Fredet and René Fabre Study of the localisation in the organism of the alkyl derivatives of malonyl urea In injections of diethylmalonyl urea (veronal) and allylisopropylmalonyl urea, it has been proved that these compounds fix themselves selectively on the nervous centres, brain and spinal column —Mme Phisalix Autopsy of a reticulated python (*Python reticulatus*) measuring 5 75 metres in length —Robert Weill The nematocysts and spirocysts of the Cœlenterata Mode of working and differential characters —O Duboscq and P Grassé The parabasal apparatus of the Flagellæ and its signification

WASHINGTON, D C

National Academy of Sciences (Proc Vol 10, No 12, December) —H B. Wahlin The mobilities of the positive ions in helium The mobility of the positive ion in air decreases if the ion is allowed to "age" before it enters the field in which its mobility is to be measured, due probably to the fact that ions consist of clusters of molecules and not of single charged molecules A similar result was obtained in helium, but the mobility curves show two definite breaks, due possibly to the presence of two types of aged and two types of unaged ions —G P Baxter and H W Starkweather The density of oxygen Little novelty of method is claimed Three globes were used and weighed by direct comparison with similar exhausted sealed globes Oxygen was prepared by (1) electrolysis of dilute sulphuric acid, (2) electrolysis of aqueous sodium hydroxide, (3) heating potassium permanganate, (4) heating potassium chlorate and manganese dioxide The average value for the density found from the three series of experiments considered most trustworthy is 1 42901 corrected to 0° C and 760 mm at sea-level, lat 45°, and this is also the average for the whole set of 22 experiments, each of which consisted of three determinations The value generally accepted hitherto is 1 42905 The new density gives the limiting value of the molal volume under standard conditions as 22 415 litres —C T Brues Observations on the fauna of thermal waters The observations refer chiefly to the thermal springs of the Yellowstone National Park Characteristic of the conditions are the high temperature, presence of unusual quantities of inorganic salts, deficiency of dissolved oxygen, and excess of carbon dioxide Plants without chlorophyll exist in water at 70°-89° C, and green algæ at 60°-77° C, animal life is found in water at 46°-52° C, but is scarce above 40°-42° C The present fauna includes Protozoa, Arthropoda, Mollusca, and cold-blooded vertebrates, and is generally similar to a brackish-water fauna This seems to be due to their both deriving from fresh-water organisms —W E Castle On the occurrence in rabbits of linkage in inheritance between albinism and brown pigmentation A race of rabbits with brown pigmentation of the coat gave 25 per cent pink-eyed and white-coated young with brown at the extremities (Himalayan albinism) Brown is recessive to black pigment and Himalayan albinism to brown The two recessive characters are relatively loosely linked in inheritance Previous cases of linkage in mammals show less than 20 per cent of crossing over, here more than 40 per cent occurs —E Hille A general type of singular point —J W Alexander Topological invariants of manifolds —F G Benedict and Cornelia Golay Benedict (1) The neutral bath and its relation to body heat Oxygen consumption was used as an index of the basal metabolism of four trained subjects, one woman and three men, first in the laboratory at 15° C and afterwards in a bath of water at 33°-38° C (neutral bath used as a sedative in psychiatric clinics) The oxygen consumption of the men showed an increase, while that of the woman was practically unchanged The bath does not tend to lower the metabolism, and the heat production under these conditions is independent of the heat lost to the environment and therefore of the surface area —(2) Body posture and minor muscular movements as affecting heat production Oxygen consumption while standing was about 10 per cent greater, and while sitting 2-3 per cent greater, than while lying down Movements such as raising one arm or crossing the legs at intervals of less than 1 min also cause increases, and must therefore be proscribed while measuring basal metabolic rates

Official Publications Received.

University of Illinois Engineering Experiment Station Circular No 12 The Analysis of Fuel Gas By Prof S W Parr and F E Vandeveer, Pp 41 (Urbana, Ill) 20 cents

The Use of Fish for Mosquito Control Pp 120 (New York The Rockefeller Foundation)

British Museum (Natural History) Picture Postcard Set G 7 Restorations of Extinct Reptiles Series No 1 10 cards in Monochrome (London British Museum (Natural History)) 1s

British Museum (Natural History) Report on Cetacea stranded on the British Coasts during 1923 and 1924 By Sir S F Harmer Pp 34 +1 map (London British Museum (Natural History)) 3s

International Geographical Union Report for the period July 1922–December 1924, with Lists of the National Committees and the Statutes, etc Edited by Sir Charles Close Pp 64 (London Printed by Harrison and Sons, Ltd)

Geological Survey of Uganda Memoir No 1 Petroleum in Uganda By E J Wayland Pp 61+4 maps (Entebbe) 5s net

Agricultural Research Institute, Pusa Bulletin No. 147 List of Publications on Indian Entomology, 1922 (Compiled by the Imperial Entomologist) Pp 42 7 annas Bulletin No 155 List of Publications on Indian Entomology, 1923 (Compiled by the Imperial Entomologist) Pp 59. 11 annas (Calcutta Government of India Central Publication Branch)

Catalogue of Indian Insects Part 4 Trypetidæ (Trypaneidæ) By R Senior-White Pp iii+33 8 annas Part 5 Nitidulidæ By S N Chatterjee Pp vi+40 10 annas (Calcutta Government of India Central Publication Branch)

Ministry of Finance, Egypt Survey Department Geological Survey of Egypt Palæontological Series, No 6 Catalogue des invertébrés fossiles de l'Égypte representés dans les collections du Musee de Géologie au Caire Par R Fourtau. Terrains Jurassiques 1re partie Echinodermes Pp xi+39+5 planches (Cairo Government Publications Office) 5 P T

National Institute of Industrial Psychology Annual Report and Statement of Accounts for the Year ended 31st December 1924, to be presented at the Fourth Annual Meeting of Members to be held at the Offices of the Institute, 329 High Holborn, London, W C 1, on Wednesday, 25th of March 1925, at Five p m Pp 17 (London 329 High Holborn, W C 1)

Conseil Permanent International pour l'Exploration de la Mer Rapports et Procès verbaux des Réunions Vol 36 A Short Account of the Statistics of the Sea Fisheries of England and Wales By T Edser Pp 27 (Copenhague Andr Fred Host et fils)

Report of the Rugby School Natural History Society for the Year 1924 Pp 42 (Rugby)

Diary of Societies.

SATURDAY, MARCH 28

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Doncaster), at 11 A M

MIDLAND INSTITUTE OF MINING ENGINEERS (at Danum Hotel, Doncaster), at 2 15 —Prof J A S Ritson and W L Grassham Notes on Devices to prevent Overwinding —J H Cockburn Mines (Working Facilities and Support) Act, Part I , 1923 —Dr E W Smith and F S Townend Manufacture of Coke-oven Coke

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof J H Ashworth The Nervous System and some Reactions (I) Of Ciliate Protozoa and Sea Anemones

MONDAY, MARCH 30

INSTITUTE OF ACTUARIES, at 5 —R D Anderson Apportionment of a Trust Fund between Life Tenant and Reversioner

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7 —Informal Discussion on Road *v* Rail Transport

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St Mary's Parsonage, Manchester), at 7 15 —Informal Meeting

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Hotel, Leeds), at 7 15 —G F Pickering Examination of Oxidation Products from Fatty Acids and Oleines —Prof N M Comber The Laboratory Examination of Soils

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —A B Pite The Architectural Treatment of Ferro-Concrete

TUESDAY, MARCH 31

ROYAL DUBLIN SOCIETY (at Royal College of Surgeons, Dublin), at 4 15 —Prof H Pringle The Identity of Vitamin A The Comparative Effects of Human and Cow Milk —Prof J Wilson The Variations in the Quantities of Food required by Cattle for Maintenance and Fat Production with various kinds of Rations

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H Cameron Some Forms of Vomiting in Infancy (Lumleian Lectures) (II)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof A. S Eddington The Internal Constitution of the Stars (II)

ROYAL SOCIETY OF MEDICINE, at 5 30 —Dr W Langdon Brown, Prof Swale Vincent, L Pugh, Dr H Gardiner-Hill, K Walker, Dr L Williams, Dr H Crichton Miller, J E R McDonagh, and others Special Discussion on Endocrine Therapy

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 6 30 —Annual General Meeting —At 7 —A Pereira Personal Reminiscences of the Mount Everest Expedition, 1924

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers' Club, Manchester), at 7 —Annual General Meeting

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7 15 —Dr R Lessing The Inorganic Constituents of Coal

HULL CHEMICAL AND ENGINEERING SOCIETY (at Grey Street, Hull), at 7 45 —Capt T G Leggott Modern Engineering Development

WEDNESDAY, APRIL 1

WOMEN'S ELECTRICAL ASSOCIATION (at 26 George Street, Hanover Square), at 3 —Miss M Partridge What is Electricity?

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6 —Major A G Lee and A J Gill The Leafield Coupled Arc

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7 —Annual Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —Col T F Purves The Post Office and Automatic Telephones

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7 30

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8 —W Dickson Quantitative Estimation of Cotton, Linen and Wood Fibres in Paper Pulp —Dr J C Drummond Vitamins in Bread —G D Elsdon Proposed Standards for Lemon Cheese Discussion on the Desirability of Standards for Food Products —Dr P H Prausnitz Demonstration of Laboratory Filters made of Sintered Glass and their Various Uses

ROYAL SOCIETY OF ARTS, at 8 —W Nunn Siam Its Prospects and Possibilities

ENTOMOLOGICAL SOCIETY OF LONDON, at 8

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8 30 —Sir Charles Ballance, L Colledge, and L Bailey Some Results of the Experimental Anastomosis of Certain Nerves with Neighbouring Nerves (with Cinematograph Demonstration)

THURSDAY, APRIL 2

ROYAL SOCIETY, at 4 30 —Prof H E Armstrong Studies on Enzyme Action XXIII The Oxidase Effect and the Phenomena of Oxidation in General Carbonic Oxide —N K Adam and G Jessop An Explanation of the so-called Intertraction Phenomenon between Solutions and the Molecular Significance of Negative Surface Tension —*To be read in title only* —Dr Jane Sands Investigation of Oxidation in the Blood of Earthworms —R Snow Conduction of Excitation in the Leaf of *Mimosa Spegazzinii* —Dorothy Adams Investigations on the Crystal line Lens

LINNEAN SOCIETY OF LONDON, at 5 —W C F Newton The Cytology of the Genus Tulipa —W R B Oliver Biogeographical Relations of the New Zealand Region

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H Cameron Some Forms of Vomiting in Infancy (Lumleian Lectures) (III)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —T Thorne Baker Chemical and Physical Effects of Light (II) Transmission of Light Images by Electricity

CHILD STUDY SOCIETY (at Royal Sanitary Institute), at 6 —Ben Greet Plays for Children

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —H M Sayers and others Discussion on Electricity Supply Tariffs —G Wilkinson and R McCourt Electricity Supply Tariffs Their Simplification by Discrimination

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House, Adelphi), at 7 30

CHEMICAL SOCIETY, at 8 —C S Gibson and J L Simonsen The Formation of *d* 2 2 4-trimethyl*cyclo*hexan-3-one 1-carboxylic Acid from *d*-camphorquinone —W H Gray Aromatic Esters of Acylecgonines

FRIDAY, APRIL 3

ROYAL SOCIETY OF MEDICINE, at 5 —Dr J Freeman, Dr B Kelly, and others Discussion on Paroxysmal Rhinorrhœa, or Vaso motor Rhinitis

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Demonstration of Acromegaly and Allied Disorders of Growth

PHILOLOGICAL SOCIETY (at University College), at 5 30 —Prof W A Craigie Dictionary Evening

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6 —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual Meeting) (at 16 St Mary s Parsonage, Manchester), at 7 —Dr C H Lander Smokeless Fuel and Oil

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Discussion on Modern Developments of Gas Production

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —G W Tookey Engineering Contracts

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 —E A Davies Ships' Life-Saving Appliances

ROYAL AERONAUTICAL SOCIETY (Scottish Branch), at 8 —Major G H Scott The New Empire View of Airships and the Practical Possibilities arising therefrom

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Daniel Hall The Productivity of English Land

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool) —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St Mary's Parsonage, Manchester) —Annual General Meeting

SATURDAY, APRIL 4

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof J H Ashworth The Nervous System and some Reactions (II) Of Marine Annelids and Earthworms

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich) —J Reid Moir The Antiquity of Man in Ipswich (Presidential Address)

PUBLIC LECTURE.

SATURDAY, MARCH 28

HORNIMAN MUSEUM (Forest Hill), at 3 30 —H. N Milligan Living Animals of the Sea-shore